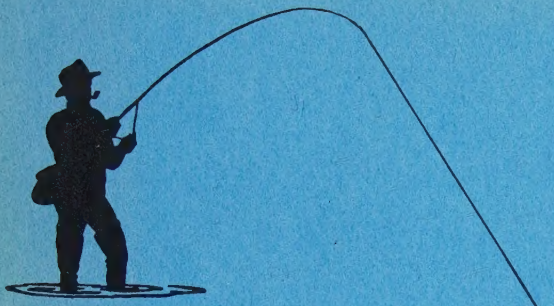
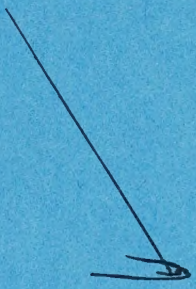


APR 2 1973
FISH & WILDLIFE SERVICE

SPORT FISHERY ABSTRACTS



Vol. 17, No. 4, 1972

Abstracts 15284 - 15634

DEPARTMENT OF THE INTERIOR
U. S. FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

DEPARTMENT OF THE INTERIOR

U. S. FISH AND WILDLIFE SERVICE

BUREAU OF SPORT FISHERIES AND WILDLIFE

Use of funds for printing this publication approved by the Director of the Office of Management and Budget November, 1970

Prepared in the Division of Fishery Research

Narragansett, Rhode Island

SPORT FISHERY ABSTRACTS

An abstracting service for fishery research and management

Vol. 17, No. 4 Abstracts 15284-15634 1972

Sport Fishery Abstracts is intended to furnish fishery biologists in government agencies and educational institutions with abstracts of the current literature in sport fishery research and management. Abstracts of published articles on limnology, ecology, natural history and other fields of specialization are included when the subject has application to the conservation and management of sport fishery resources.

One volume consisting of four numbers is issued each year. Each number contains separate Author and Subject indexes. The final number of each volume contains cumulative Author and Subject indexes and a list of publications screened.

Suggestions for improving the usefulness and scope of Sport Fishery Abstracts are solicited.

The Bureau of Sport Fisheries and Wildlife of the U. S. Fish and Wildlife Service assumes no responsibility for the accuracy of material from outside sources, and can only supply copies of articles written and published by the U. S. Fish and Wildlife Service. Requests for other articles should be sent to the author or publisher.

Robert M. Howland, Editor
Gertrude Kavanagh, Asst. Editor

Authors who believe their publications should be included in Sport Fishery Abstracts are asked to submit abstracts to:

Editor, Sport Fishery Abstracts
Bureau of Sport Fisheries and Wildlife
General Delivery, U. S. Post Office
Narragansett, Rhode Island 02882

Translations done in the Division of Fishery Research, Bureau of Sport Fisheries and Wildlife are available only on loan for reproduction, due to the limited number of copies.

15284. Wahtola, C. H., B. L. Evenhuis and J. B. Owen (Dept. of Biol., Univ. of No. Dakota, Grand Forks, North Dakota 58201). 1971. THE AGE AND GROWTH OF THE YELLOW PERCH Perca flavescens (Mitchill) IN THE LITTLE MISSOURI ARM OF LAKE SAKAKAWEA, NORTH DAKOTA, 1968. Proc. of the No. Dakota Academy of Science, Vol. 24, pp. 39-44.

Yellow perch in the Little Missouri Arm of Lake Sakakawea were found to have a maximum life span of four years. Average calculated lengths of male and female perch indicated that growth was most rapid in the first year of life, and was somewhat reduced in the second and third years. The length-frequency polygon clearly showed peaks for age classes 0 and I, an apparent absence of age class II and one broad peak for age classes III and IV. The absence of a peak for Age class II in the length-frequency polygon may be due to a reproductive failure in 1966. The coefficient of condition, K-TL, of the yellow perch population had a rather low overall average. Age class III had the poorest condition, whereas age class II had the best. The overall sex ratio for 1,968 fish was found to be 2.38 females per male. The mesh selectivity was the most striking aspect of the study. Of the 834 taken in gill nets 802 (94%) were caught in the 3/4 inch mesh. (From authors results)

15285. Storr, J. F., and R. A. Sweeney (Biol. Dept., State Univ. of New York at Buffalo, New York). 1971. DEVELOPMENT OF A THEORETICAL SEASONAL GROWTH RESPONSE CURVE OF Cladophora glomerata TO TEMPERATURE AND PHOTOPERIOD. Proc. 14th Conf. Great Lakes Res., pp. 119-127 Internat. Assoc. Great Lakes Res.

A series of experiments were carried out in the laboratory to relate rate of growth to the filamentous alga C. glomerata to temperature and photoperiod. The results of these experiments indicated that at the level of nutrients present, optimum growth was in the 18°C (64.5°F) temperature range. Low levels of growth were found at the low temperature range of the experiments but the results were not conclusive. In the upper temperature range of growth, cessation appeared to be at about 25°C (77.0°F). Growth response to levels of photoperiod in the experiments appeared to be exponential in character while the growth response curves generated by the temperature experiments were very similar in form at the different levels of photoperiod. Using these results a family of temperature related growth curves were constructed for different photoperiods throughout the May-October period. Recorded water temperature data from the lakes was plotted on these curves for the same period and a seasonal growth response curve was generated relating seasonal photoperiod and temperature. This resultant plot appeared to be in close agreement with observed Cladophora growth throughout the season. The theoretical growth curve may be valuable in reconstructing past growth response and in predicting growth response to temperature in a particular location. (From authors)

15286. Flain, M. (Fish. Lab., Marine Dept., Christchurch, New Zealand). 1971. AGE AND GROWTH OF QUINNAT SALMON Oncorhynchus tshawytscha (Walbaum) IN THE RANGITATA RIVER, 1970 AND 1971. Fish. Div. Reprint No. 43, N. Z. Marine Dept. from the 85th Ann. Report of the Ashburton Acclimatisation Society.

The age structure of the 1970 and 1971 runs in the Rangitata River fits the normal pattern for Quinnat salmon in New Zealand: A - III year class dominant; B - IV year class second most important (sometimes dominant year class); C - II year class third in importance (sometimes second most important) II year males considerably out-number II year females, the occurrence of the latter is a distinctive feature of New Zealand runs, and is not recorded for North American runs; D - V year class rare; E - Older than V not observed (in any New Zealand runs). The age composition and growth rates are directly comparable with those of other sea runs of salmon in New Zealand rivers, but like the runs in other rivers they are younger at maturity than those runs that occur in North America.

15287. Latta, W. C. 1972. DEVELOPMENT OF MEROMIXIS IN TWO SMALL LAKES IN MICHIGAN. Mich. Dept. of Natural Resources Research and Development Report No. 263, 14 p. includes 4 tabs. + 3 figs.

15288. Wyatt, T. (Fish. Lab., Lowestoft, Suffolk, England). 1972. SOME EFFECTS OF FOOD DENSITY ON THE GROWTH AND BEHAVIOUR OF PLAICE LARVAE. Marine Biology, 14(3): 210-216.

The effect of food density on the growth, survival, and swimming activity of plaice larvae (Pleuronectes platessa L.) was investigated under controlled laboratory conditions. Sub-optimal food concentrations decrease the growth of the height of the body musculature relative to length, and increase the amount of time spent searching for food. Older larvae are able to withstand much longer periods without food than young larvae. On the basis of these experiments, it is suggested that food limitation in a larval plaice population is likely to result in a concave mortality curve. (Auth.)

15289. Hunt, P. C., and J. W. Jones (Dept. of Zool., Univ. of Liverpool, England). 1972. TROUT IN LLYN ALAW, ANGLESEY, NORTH WALES. II. GROWTH. J. Fish Biol., 4(3): 409-424.

The annual and seasonal growth, length/weight relationship, changes in seasonal condition and specific growth rates of 17 types of trout in the newly flooded reservoir, Llyn Alaw, in Anglesey, North Wales, were investigated. Scales and length-weight data from 2076 trout caught by angling and netting during the first 4 years after impoundment were analysed to show the age, origins and growth of all fish both before and after flooding. (Authors)

15290. Edwards, R. R. C., D. M. Finlayson, and J. H. Steele (Marine Lab., Aberdeen, Scotland). 1972. AN EXPERIMENTAL STUDY OF THE OXYGEN CONSUMPTION, GROWTH, AND METABOLISM OF THE COD (Gadus morhua L.). J. exp. mar. Biol. Ecol., 8(3): 299-309.

The rate of oxygen consumption of cod in sea water at 12°C containing MS 222 (25 mg/l) can be expressed as: $Q_{O_2} = 0.245\ W^{0.82}$ (mg/h), where W is the live weight of the fish (g). The maximum efficiency of conversion of assimilated food into growth was 24% during the feeding experiment. Digestion efficiencies were estimated at over 98% using fillets of plaice as food. The effect of increasing the rate of food intake was to increase liver weight and condition factor. The relative proportions of protein and lipid in the body did not change over the range of feeding levels used. The conversion efficiency had a maximum value at an intermediate feeding rate. (Authors)

15291. Campbell, N. A., and B. F. Phillips (Div. of Mathematical Statistics, CSIRO, Private Bag, Post Office, Wembley, Western Australia, 6014). 1972. THE VON BERTALANFFY GROWTH CURVE AND ITS APPLICATION TO CAPTURE - RECAPTURE DATA IN FISHERIES BIOLOGY. J. Cons. int. Explor. Mer., 34(2): 295-299.

The Von Bertalanffy growth curve is given by $L = L_\infty [1 - \exp\{-k(t - t_o)\}]$ (1) where L_∞ is the maximum length attained, and L is the length of the animal at time t. Capture-recapture data are usually of the form (L_{i-1}, L_i, d_i) where L_{i-1}, L_i are the lengths at release and recapture and d_i is the time interval between. Procedures are available for estimating the parameters L_∞ and k. Alternatively, data can be transformed to the form (L_i, t_i), using an iterative procedure to fit the model, as discussed by the authors in a previous paper. Other commonly used approaches involve the graphical estimation of growth parameters by plotting the length at recapture, L_i, against the length at release, L_{i-1}, from the same individual. For the time interval d_i between recaptures, a straight line with slope $\exp[-kd_i]$ results. However when d_i is varying, a non-linear function is obtained and an iterative solution is required. When the time interval d_i is small compared with the total life of the animal the plot of length against time may be assumed linear within these intervals. The length of the animal at some fixed time interval t_f can be estimated by linear interpolation. The resulting plot of estimated length at time t_f after release against length at release gives a straight line with slope $\exp[-kt_f]$. Alternatively, differentiation of the Von Bertalanffy growth equation shows that the derivative of the length with respect to time is a linear function of the length at release. For small time intervals between recaptures this derivative is given by the increase in length from release to recapture

divided by the corresponding time interval. The regression of this derivative on the length at release gives a straight line with slope -k. These methods give similar results to those obtained from the direct fitting of non-linear models to data in capture-recapture form. (Authors)

15292. Bernatowicz, Stanislaw. 1972. OBSERVATIONS ON THE DEVELOPMENT OF Coregonus peled (Gmel.) FRY 0+ IN PONDS. [Obserwacje nad rozwojem narybku pelugi (Coregonus peled (Gmel.)) w stawach]. Acta Hydrobiol., 14(2): 165-172. In Polish with English abstract.

The main difficulty encountered in the production of stocking material of Coregonus peled in ponds are high losses the first year of age. Observations were made on the growth of Coregonus peled fry in the period from spring to autumn. Growth rate, condition, survival, and parasites were also considered. (Auth.)

15293. Kapoor, N. N. (Dept. of Biol., McMaster Univ., Hamilton, Ontario, Canada). 1971. LOCOMOTORY PATTERNS OF FISH (Lepomis gibbosus) UNDER DIFFERENT LEVELS OF ILLUMINATION. Anim. Behav., 19(4): 744-749.

The fish, Lepomis gibbosus, displayed a characteristic pattern of turnings under various illumination levels. The steady state locomotory pattern of these fish under standard light (1 lx) and bright light (1·2 lx) changed to a new pattern in dim light (0·6 lx) and darkness (<0·6 lx). Present observations suggest that the level of illumination has a definite effect on the turning behaviour, and pumpkinseed displayed left- or right-handedness in their movements. Blinded pumpkinseed showed the same frequency distribution of turnings ('jumps') as did normal fish under standard, dim light and darkness. It may be concluded that for any change in steady-state pattern of turning, light perception per se is more pertinent than optical perception. (Auth.)

15294. Wallace, L. 1972. REACTIONS OF THE SHARKS Carcharhinus leucas (Müller & Henle) AND Odontaspis taurus (Rafinesque) TO GILL NET BARRIERS UNDER EXPERIMENTAL CONDITIONS. South African Assoc. for Marine Biol. Research, Oceanographic Research Inst. Investigational Report No. 30, 24 p. illus.

The experiments reported in this paper were designed to investigate the reactions of captive sharks to the type of netting barriers used in Natal. Investigated were: detection of nets of different colors; the ability to locate and pass through a small hole in a net barrier; reactions to bottom and surface nets during the day, at dusk and in the dark; reactions to gaps between nets. It is concluded that sharks have greater difficulty in detecting colored objects of low reflectivity. Although sharks located a hole in the net by chance it appears that they passed through it deliberately. The experiments suggest that some sharks have a diurnal change in swimming depth, swimming near the bottom during the day and near the surface at night; it is recommended that full depth nets be used to protect bathing areas. When overlapping nets were easy to detect sharks swam through the gap between them.

15295. Herricks, Edwin E., and John Cairns, Jr. (Dept. of Biol., and Center for Environ. Studies, Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia). 1972. THE RECOVERY OF STREAM MACROBENTHIC COMMUNITIES FROM THE EFFECTS OF ACID MINE DRAINAGE. Published in 4th Symposium on Coal Mine Drainage Research Inst., Mellon Inst., April 26-27, 1972.

Under conditions of constant acid discharge recovery of downstream aquatic communities is not as rapid as has been reported previously. Both biological and chemical effects of acid drainage in Indian Creek vary with season depending on acid drainage - stream volume relationships between the acid source and the receiving stream. The effects of acid drainage on water quality include a decrease in pH, increase in sulfates and iron, and an increase in the acidity/alkalinity ratio. The effect of acid drainage on aquatic communities include a reduction in diversity ($\bar{d}$) and density and dominance by tolerant organisms. Recovery was evidenced by establishment of communities with a large number of species most of which were represented by relatively few individuals. Tributaries improve water quality by dilution, and supply organisms to reinvade the damaged regions of the stream from which they had been eliminated. (Authors conclusions)

15296. Skidmore, J. F., and P. W. A. Tovell (Dept. of Zool., Univ. of Bristol, Bristol 5, England). 1972. TOXIC EFFECTS OF ZINC SULPHATE ON THE GILLS OF RAINBOW TROUT. Water Research, 6(3): 217-230.

The initial changes that occur in the gill tissue of rainbow trout exposed to 40 ppm Zn^{2+} are typical of an acute inflammatory reaction. The epithelium covering the secondary lamellae lifts away in a continuous sheet from the pillar cell system, thus increasing the diffusion distance from water to blood. Blood flow patterns through the lamellae change, granulocytes appear in large numbers within the lamellar blood spaces and beneath the raised epithelium. Finally the lamellar blood circulation stagnates, terminating in respiratory collapse and death of the animal. The dynamics of blood flow during the progressive stages of gill damage are discussed. (Authors)

15297. Wildish, D. J. (Fish. Res. Bd. of Canada Biol. Sta., St. Andrews, New Brunswick, Canada). 1972. ACUTE TOXICITY OF POLYOXYETHYLENE ESTERS AND POLYOXYETHYLENE ETHERS TO S. salar AND G. oceanicus. Water Research, 6(7): 759-762.

Polyoxyethylene ethers are more toxic to aquatic fauna than polyoxyethylene esters. Polyoxyethylene (4) lauryl ether is 9 times more toxic than polyoxyethylene (14) monolaurate at the ILL to Salmo salar L., and 14,000 times more toxic at the 96-h LC50 to Gammarus oceanicus Sergestrale. (Auth.)

15298. Goodman, Joel H., and David G. Butler (Ramsay Wright Zool. Labs., Univ. of Toronto, Toronto 181, Canada). 1972. LOCALIZATION OF 4-^{14}C CORTISOL IN THE GILLS OF THE NORTH AMERICAN EEL (Anguilla rostrata LeSueur). Comp. Biochem. Physiol., 42(2A): 277-296.

Gills of fresh-water North American eels (Anguilla rostrata LeSueur) bound relatively large amounts of injected 4-^{14}C cortisol compared to the reference steroid 4-^{14}C progesterone. Two hr after the injection of labelled cortisol, the gills contained 2005 dpm (52 percent authentic cortisol) the gill/plasma ratio being 0·721, whereas after the same period the gills from eels injected with radioactive progesterone contained only 665 dpm, the gill/plasma ratio being 0·250 ($P<0.005$). Radioactive cortisol was transformed to authentic radioactive cortisone but the latter compound was not localized in the gills. The localization of cortisol in eel gills is discussed in relation to the endocrine control of active sodium transport. (Authors)

15299. Stadnyk, Lelyn, Robert S. Campbell, and B. Thomas Johnson (Div. of Biol., Univ. of Mo., Columbia, Missouri). 1971. PESTICIDE EFFECT ON GROWTH AND ^{14}C ASSIMILATION IN A FRESHWATER ALGA. Bull. of Environ. Contamination & Toxicology, 6(1): 1-8.

This investigation evaluated the effects of pesticides on low density populations of a freshwater alga in terms of changes in growth and metabolism rather than death. Pesticides diuron, carbaryl, 2,4-D, DDT, dieldrin, toxaphene and diazinon[3] were investigated under static conditions. The most conspicuous effects of pesticides on algal subcultures of Scenedesmus quadricaudata were found with the herbicide diuron and the insecticide carbaryl. There was a drastic reduction in cell numbers which continued throughout an 8-day period. This decline was reflected in a conspicuous decrease in biomass: final dry weight 0.05 mg/l in the treated subcultures as opposed to 46.8 mg/l in the controls, and a significant suppression of carbon assimilation. Subcultures treated with both 0.1 and 1.0 mg/l diuron showed reduced carbon assimilation by approximately 90 percent within 4 days. Carbaryl, in contrast to diuron, stimulated cell growth concomitant with an increase in carbon assimilation. Cell biomass at the end of 6 days had increased 44 to 57 percent in the 0.1 and 1.0 mg/l treated subcultures as opposed to the controls. The herbicide 2,4-D produced less severe metabolic changes than did diuron. The persistent organochlorine insecticides DDT, dieldrin and toxaphene all decreased cell number at all levels of treatment. Diazinon was the only compound tested which had no effect on algal cell number, biomass or ^{14}C uptake.

15300. Kemp, H. T., J. P. Abrams and R. C. Overbeck. 1971. EFFECTS OF CHEMICALS ON AQUATIC LIFE. Water Quality criteria data book, Vol. 3, 528 p. Environmental Protection Agency, Water Pollution Control Research Series, 18050 GWV; Univ. of Wisconsin Water Resources Center Eutrophication Program Issue No. 29, Eutrophication: A bimonthly summary of current literature, p. 5, abstract No. 3930, April-May 1972.

Available scientific information is summarized concerning specific chemical effects on aquatic species and procedural and environmental details relative to these effects. Information on aquatic life, as applicable to water pollution and methodology used in studying chemical effects, is reviewed.

15301. Amend, Donald F. (Bur. of Sport Fish. & Wildl., Western Fish Disease Lab., Seattle, Washington 98115). 1972. EFFICACY, TOXICITY, AND RESIDUES OF NIFURPIRINOL IN SALMONIDS. U. S. Dept. of the Interior, Technical Papers of the Bur. of Sport Fish. & Wildl. No. 62, 13 p.

Nifurpirinol (NFP), also known by the code name P-7138, was tested for control of furunculosis, myxobacterioses, and vibriosis, and for effects on rainbow trout, coho, and chinook salmon under various conditions. The elimination of NFP from various tissues of coho salmon at 45° and 70° F was measured. Furunculosis in coho salmon was partially controlled with 2 daily 1-hour baths at 8 or 10 ppm NFP; it was not controlled by feeding the drug because the fish refused to eat the medicated food. Excellent control of myxobacterioses (columnaris, cold-water disease, myxobacterial gill disease, etc.) followed 1 or 2 daily 1-hour treatments at 1 ppm NFP. Preliminary tests indicated that loss of chinook salmon due to vibriosis could be reduced with NFP fed at 50 to 75 mg/kg per day for 14 days. The reason chinook salmon ate the medicated food and coho salmon did not is not known. The toxicity of NFP to coho varied directly with dosage level, treatment frequency, and water temperature. Single 1-hour exposures were not toxic at levels up to 10 ppm, but repeated exposures to 6 ppm or higher at 24-hour intervals resulted in increased mortality. Toxicity was greater at higher water temperatures. Results were similar with chinook salmon and rainbow trout. NFP was eliminated from all tissues of cohos within 9 days following 3 daily 1-hour exposures at 2 ppm at both 45° and 70° F. The highest levels occurred in the liver and kidney, and it especially accumulated in these tissues at 45° F. Muscle, serum, and skin drug levels were highest immediately following treatment, but were undetectable after 48 hours. It was concluded that NFP administered as a 1-hour bath to cohos at 1 ppm on 1 to 3 consecutive days will effectively control myxobacterial diseases. It is of low toxicity and poses no residue problems 9 days after the last treatment. Further tests are needed to verify the use of NFP for control of other bacterial diseases. (Auth.)

15302. Fowler, Laurie G., Joe L. Banks, and Joseph W. Elliott (Bur. of Sport Fish. & Wildl., Salmon-Cultural Lab., Longview, Washington 98632). 1972. TESTS OF VARIATIONS OF THE ABERNATHY SALMON DIET, 1970. U. S. Dept. of the Interior, Technical Papers of the Bur. of Sport Fish. & Wildl., No. 61, 13 p.

The 1970 fall chinook salmon (Oncorhynchus tshawytscha) feeding trials indicated that dry pelleted diets were equal to moist pelleted diets with similar formulations. A superior diet was produced by reducing the ratio of dried whey product and wheat germ meal to 1:1 and eliminating cottonseed meal. This formulation fed at a 45 percent protein level was more efficient than other protein levels fed. Growth was not reduced when the soybean oil supplement was lowered from 6 percent to 2 percent of the diet. Two corn distillers' products that were substituted as partial replacements for dried whey product did not enhance fish growth. Storage of the Abernathy dry pellet at room temperature did not alter the nutritional adequacy of the diet. (Authors)

15303. Kay, Wendy (editor). 1972. CONSERVATION DIRECTORY 1972. The National Wildlife Federation, 1412 16th St., N.W., Washington, D. C. 20036, 165 p., price $2.00.

A listing of organizations, agencies and officials concerned with natural resource use and management.

15304. Niimi, A. J. (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1972. CHANGES IN THE PROXIMATE BODY COMPOSITION OF LARGEMOUTH BASS (Micropterus salmoides) WITH STARVATION. Can. J. Zool., 50(6): 815-819.

The bioenergetics of starvation of largemouth bass (Micropterus salmoides) was determined through integrating changes in proximate body composition, energy yields, and changes in weight. Weight losses during starvation showed good correlation with changes in proximate body composition. After adjustments for relative increases in the proportion of moisture were made, tissue utilization and the corresponding energy equivalents were estimated. The energy requirements over the 40-day starvation period were derived from lipid and protein at a 60:40 ratio. (Auth.)

15305. Arcarese, G., G. Ravagnan, and P. Ghittino (Capo Laboratorio Centro Ittiologico Valli Venete (CIVV), Val Pisani, 45010 Ca Venier (Rovigo), Italy). 1972. FIRST POSITIVE RESULTS IN THE ARTIFICIAL PROPAGATION OF SEA BASS (Dicentrarchus labrax) ON A VAST SCALE. [Primi risultati positivi di fecondazione artificiale nel branzino (Dicentrarchus labrax) su vasta scala]. Riv. It. Piscic. Ittiop., 7(2): 27-33. In Italian with English abstract.

A group of Italian brackish-water fish farmers ("vallicoltori") founded in 1967 the "Ichthyologic Center Venetian Lagoons (ICVL)" at Val Pisani, Ca Venier, Rovigo, Italy. The Center studies the details related with the modernization of brackish-water fenced lagoons ("valli"), especially with their intensification. The fish farmers of this area are assisted in the problems arising in the ecology, biology, physiology, husbandry, and pathology of the main cultured fish-species. Particular attention was paid to the artificial reproduction of fish grown in fenced lagoons. This aim is extremely important in the modern form of this kind of fish husbandry. In the frame of this program, recently the artificial insemination of sea bass (Dicentrarchus labrax) was investigated. The authors relate in this paper the methods and results obtained with this valuable species. Sea bass were caught in Orbetello's Lagoon, sorted according to their sexual ripeness, and kept in indoor tanks supplied with 36 ‰ salinity, 16-18°C, filtered and recirculating sea water. Only females were injected with carp pituitary dry extracts (0.5 carp hypophysis/kg body weight), once or several times, while males were spontaneously ripe. Dry insemination, and egg incubation according to "Yashouv's method", succeeded in obtaining high levels of fertilization and hatching rate (roughly 80%). The optimum incubating temperature was 13-15°C; the number of day-degrees for the sea bass was 15-18. Approximately 4 - 5,000,000 larvae were so obtained. The maximum period of survival observed so far was even 60 days. Under the supervision of ICVL, the feeding of sea bass fry is being investigated. An important research center for the commercial artificial propagation of sea fish is scheduled to be built in Italy, with the purpose of utilizing the favorable results mentioned above. (Authors)

15306. Ghittino, P., S. Andruetto, and E. Vigliani (Centro Studi Malattie Pesci Istituto Zooprofilattico Sperimentale del Piemonte e della Liguria - Via Bologna, 148 - 10154 Torino, Italy). 1972. "RED MOUTH" ENZOOTIC IN HATCHERY RAINBOW TROUT CAUSED BY Vibrio anguillarum. (Enzoozia di "bocca rossa" in trote iridee di allevamento sostenuta da Vibrio anguillarum). Riv. It. Piscic. Ittiop, 7(2): 41-45, illus. In Italian with English abstract.

The authors describe a "Red Mouth" (RM) enzootic in hatchery rainbow trout caused by Vibrio anguillarum. The affected Italian trout farm was small, comprised of earthen ponds, supplied with sparse spring fresh water, and fish were fed slaughter by-products (70-80%) and dry meals (20-30%). Mortality was slight and trout showed macro and microscopic septicaemic lesions, which were characteristic of RM syndrome. The etiologic agent was isolated in pure culture from the kidney of dead fish on common agar and broth, incubated at room temperature. Therapy with chloramphenicol, included in the food at 6-7 gr/100 kg. of fish body weight per day for 6-7 days, stopped all mortality. The authors reached the V. anguillarum identification with the cooperation of Eastern Fish Diseases Laboratory, Leetown, W. Virginia, USA, and through their own studies. Further tests are in progress with specific anti V. anguillarum sera. The isolate produced acid, but not gas in O/F glucose and it was sensitive to the Vibriostat O/129; it did not

produce gas from carbohydrates, acidified glucose, saccharose and maltose, and did not produce indole; it grows on common broth and agar with or without 2-3% NaCl. It should be a Type C Vibrio anguillarum. The morphology of the Vibrio under the electron microscope also is given. It was not pathogenic to mice or guinea pigs. (Authors)

15307. Perkins, E. J., J. R. S. Gilchrist, and O. J. Abbott (Univ. of Strathclyde, Mar. Lab., Garelochhead, Dunbartonshire, Scotland). 1972. INCIDENCE OF EPIDERMAL LESIONS IN FISH OF THE NORTH-EAST IRISH SEA AREA, 1971. Nature, 238(5359): 101-103, illus.

The fish of the North-East Irish Sea and Solway Firth area have been surveyed continuously since 1959. During the period until the end of 1970, epithelial lesions were not observed to a significant degree. In March 1971, however, concurrent with observations made by fishermen, a marked incidence of such disease was noted in plaice (Pleuronectes platessa) and dab (Limanda limanda). Fish from some 1,500 square miles of sea were affected. The lesions belonged to three principal categories: lymphocystis, epidermal ulcers and fin damage. With the exception of a single juvenile plaice, which had fin damage, the symptoms of each disease were confined to plaice and dab which were longer than 170 mm and the disease was most evident in fish more than 250 mm long. It must be recognized that epidemics occur periodically, but for three diseases to enter such a phase simultaneously and occur in plaice taken from some 1,500 square miles of sea suggests an abnormal situation. The Irish Sea has been used for dumping latterly, however, and was the scene of the sea-bird wreck in 1969. Some of these materials - the polychlorinated biphenyls (PCBs) - may, in sub-lethal doses, render treated animals more susceptible to the onset and influence of disease. The histology of these diseases is under investigation.

15308. Thorpe, J. E., and R. J. Roberts (Freshwater Fisheries Lab., Pitlochry, Scotland). 1972. AN AEROMONAD EPIDEMIC IN THE BROWN TROUT (Salmo trutta L.). J. Fish Biol., 4(3): 441-451.

The pathology and bacteriology of an aeromonad epidemic in the spawning population of brown trout (Salmo trutta L.) of the freshwater Loch Leven, Kinross, Scotland, is described, together with estimates of its quantitative effect on the stock of trout. (Authors)

15309. Weiss, D. M. (Salmon and Freshwater Fish. Lab., Ministry of Agric., Fish. and Food, London, England). 1972. A HIGH POWER PULSE GENERATOR FOR ELECTRIC FISHING. J. Fish Biol., 4(3): 453-459.

A pulsed d.c. fishing machine has been designed and constructed for use in fresh water, which is capable of efficiently utilizing the full power available from portable a.c. generating sets with capacities up to 1.5 kVA. High power pulses of constant voltage and variable pulse width are produced which induce electrotaxis in fish in water of all conductivities up to at least 2000 μS. The peak power available is in excess of 10 kW, the electrical efficiency is high and all components are conservatively rated in order to provide a high degree of reliability when used correctly. The instrument described has been fully field-tested and is sufficiently robust and simple in operation for routine use by personnel possessing only elementary knowledge of the principles of its operation. (Auth. summ.)

15310. Powers, Dennis A. (Div. of Biol. and Med. Research, Argonne Natl. Lab., Argonne, Illinois 60439). 1972. HEMOGLOBIN ADAPTATION FOR FAST AND SLOW WATER HABITATS IN SYMPATRIC CATOSTOMID FISHES. Science, 177(4046): 360-362.

The oxygen equilibria of Catostomus insignis hemoglobins are pH dependent. Catostomus clarkii hemoglobins have some components (20 percent) whose oxygen equilibria are independent of pH because the alpha chains have NH_2-termini that are blocked and the beta chains lack the "usual" COOH-terminal histidine. Since the Bohr effect is normally a beneficial phenomenon, the maintenance of some hemoglobins without a Bohr effect must provide a physiological advantage that is habitat specific. The intrastream ecological preferences of these sympatric catostomids suggest that the hemoglobins without the Bohr effect confer an ecological advantage in a swift water habitat. (Auth.)

15311. Eaton, Stephen W., and Larry P. Kardos. 1972. THE FISHES OF CANANDAIGUA LAKE, 1971. Science Studies, St. Bonaventure Univ., St. Bonaventure, New York, Vol. 28, pp. 23-39 + 5 tables.

From April to December 1971 we made collections of fishes by gill net, seine and fyke net in Canandaigua Lake to compare its status today with studies done in 1927 and 1945. In 1927 the cisco (Coregonus artedi) was the dominant forage fish of lake trout and by the 1940's the rainbow smelt (Osmerus mordax) had replaced the cisco. In 1971 we found the alewife (Alosa pseudoharengus) had replaced the smelt as principal forage for the lake trout (97% by volume), chain pickerel (Esox niger), smallmouth bass (Micropterus dolomieui) and walleye (Stizostedion vitreum vitreum). Notes on 34 species of fishes are presented describing their abundance, food habits and growth. Four species have been added to the known fauna - Ictalurus natalis, Noturus gyrinus, Lepomis macrochirus and Pomoxis nigro-maculatus. The tapeworm genus Eubothrium was found in over 90% of the lake trout. (Authors)

15312. Erikson, Lars-Ove (Dept. for Ecol. Zool. of the Univ. Umeå/Sweden and Ecological Station Messaure, Sweden). 1972. DAILY PERIODICITY OF BLINDED BROOK TROUT (Tagesperiodik geblendéter Bachsaiblinge). Die Naturwissenschaften, 59(5): 219-220. In German.

Activity investigations carried out for a long interval on eyeless- and eyeless and pineal- organ-operated fish prove clearly that other receptors can take over the perception of light/dark variation.

15313. Flain, M. (Fisheries Lab., Christchurch, New Zealand). 1971. GREAT LAKES CHAR Cristivomer namaycush (Walbaum). New Zealand Marine Dept. Fisheries Div. Reprint No. 46, illus.

The Great Lakes char (lake trout) imported into New Zealand and planted in Lake Pearson has survived for 65 years in this unsuitable lake. This known genetically isolated stock would allow for useful comparative work to be carried out.

15314. Smith. L. L., and D. M. Oseid (Dept. of Entomol., Fish., and Wildl., Univ. of Minnesota, St. Paul, Minnesota). 1972. EFFECTS OF HYDROGEN SULFIDE ON FISH EGGS AND FRY. Water Research, 6(6): 711-720.

Incubation of walleye, sucker, trout and northern pike eggs at levels of hydrogen sulfide often found in nature and in polluted situations has shown that these concentrations may be lethal, slow growth, extend incubation period, and result in deformed fry under most conditions. Lowered oxygen increases the adverse effects of hydrogen sulfide. At extremely low hydrogen sulfide concentrations (0.006-0.012 mg l^{-1}) growth may be stimulated without increased mortality. In some cases survival over controls may be increased. Extended incubation periods coupled with decreased survival, smaller and deformed fry at levels exceeding 0.025 mg l^{-1} H_2S strongly suggest that fish population maintenance will be greatly inhibited where levels approach these concentrations during the incubation period and in zones where eggs or fry may be found. With TL_{50} values for eggs at 4 to 10 days varying from 0.022-0.064 mg l^{-1} under different conditions of O_2 and temperature and TL_{50} for walleye fry at 0.007 mg l^{-1} it is assumed that a safe level will be below this minimum. Since a marked adverse effect is noted on walleye eggs at 0.012 mg l^{-1} at 12°C and 6 mg l^{-1} O_2 and on fry at 0.007 mg l^{-1} safe level will probably be less than 0.006 mg l^{-1}. (Authors discussion)

15315. Eslami, A. H., M. Anwar, and Sh. Khatiby (Dept. of Parasitology, Univ. of Tehran, Fac. of Vet. Medicine, P. O. Box 3262, Tehran, Iran). 1972. INCIDENCE AND INTENSITY OF HELMINTHOSES IN PIKE (Esox lucius) OF CASPIAN SEA (NORTHERN IRAN). Riv. It. Piscic. Ittiop., 7(1): 11-13. In English.

The present paper is a report on the incidence and the intensity of helminthoses in pike (Esox lucius) of Caspian Sea (Northern Iran). Helminths were found in 86 (78.9%)of the 109 pike examined, 49 fish had only one, 24 fish two, and 13 fish, three species of helminths. Triaenophorus crassus, Raphidascaris acus, and Contracaecum osculatur-baicalensis were the helminths found. The latter species was found in body cavity, and the former two in the alimentary canal.

15316. Conroy, D. A., and D. H. McCarthy (Fish Pathology Unit, The Zool. Soc. of London, Regent's Park, London N. W. 1, England). 1972. HAEMATOZOA IN THE ATLANTIC SALMON (Salmo salar L.). Riv. It. Piscic. Ittiop., 7(1): 15-16. In English.

During investigations on the haematology of the Atlantic salmon (Conroy, 1972), specimens of fish of different age groups were routinely sampled from various localities throughout Britain. In September 1970, ten wild salmon parr were taken from the Rive Exe at a point just below Tiverton, in Devon. The blood smears were stained by Leishman's technique. Haemoflagellates ascribed to the genus Cryptobia were observed from one of these parr, and the level of infection was 1-2 flagellates/200 red blood cells. No marked differences in any of the haematological parameters were apparent. During the period April-May 1971 a total of one hundred and twenty-two salmon smolts and two sea trout (S. trutta L.) smolts were captured at Pines Water Treatment Centre, near Exeter; Cryptobia sp. was detected in 33% of the salmon smolts but was absent from the sea trout smolts. A more detailed examination of the blood smears revealed the presence of intra-erythrocytic haemogregarines in 18% of the salmon smolts and in one of the two sea trout smolts. Many of the salmon had a dual infection with haemoflagellates and haemogregarines.

15317. Adron, J. W. (Inst. of Mar. Biochem., Aberdeen, Scotland). 1972. A DESIGN FOR AUTOMATIC AND DEMAND FEEDERS FOR EXPERIMENTAL FISH. J. Cons. int. Explor. Mer., 34(2): 300-305.

There is a growing interest in the nutrition of fish on defined pelleted diets. In some cases these can be fed to the fish by hand, but in other cases a mechanical feeding device is desirable. Behavioural aspects of fish feeding are also of importance when a nutritional study is undertaken. For many of these studies it is necessary to have a highly adaptable mechanical feeder. The feeder should be easy to make and maintain, be capable of dispensing diets of widely differing sizes at predetermined variable time intervals and quantities. The feeders available commercially are mainly intended for the large scale production of fish. They do not lend themselves to small scale experiments or behavioural experiments. The feeder described in this paper does fulfill some of the requirements of an experimental feeder. It is highly flexible with regard to timing, as well as quantity and size of diet delivered. The same food dispenser can be used either for automatic feeding or demand feeding. (Auth. introduction)

15318. Saksena, Vishnu P., and Edward D. Houde (Dept. of Biol., Muskingum Coll., New Concord, Ohio). 1972. EFFECT OF FOOD LEVEL ON THE GROWTH AND SURVIVAL OF LABORATORY-REARED LARVAE OF BAY ANCHOVY (Anchoa mitchilli Valenciennes) AND SCALED SARDINE (Harengula pensacolae Goode & Bean). Contribution No. 206, NMFS, Tropical Atlantic Biol. Lab., Miami, Fla.; J. exp. mar. Biol. Ecol., 8(3): 249-258.

The effect of food levels on the growth and survival of laboratory-reared larvae of scaled sardines (Harengula pensacolae Goode & Bean) and bay anchovies (Anchoa mitchilli Valenciennes) was determined. Wild zooplankton, most of which was copepod nauplii and copepodids, was used as food. H. pensacolae larvae grew 0.80 mm/day at a low (444 organisms/l) and high food level (1324 organisms/l). Survival was appreciably better (14.5%) at the low than (3.5%) at the high food level, 23 days after hatching. A. mitchilli larvae grew faster at medium and high food concentrations. Average growth rates for three replicated experiments were 0.48 mm/day at low food (621-692 organisms/l), 0.50 mm/day at medium food (1330-1688 organisms/l), and 0.54 mm/day at high food (2811-3323 organisms/l). Survival of A. mitchilli larvae, 20 to 28 days after hatching, ranged from 0.0 to 17.8% and was better at medium and high food levels than at the low food level. The results indicate that 500 to 1000 copepod nauplii and copepodids/l provided adequate food for rearing H. pensacolae but 1500-2000/l were consistently required to rear A. mitchilli. (Authors)

15319. Bridges, W. R., and Bruno von Limbach (Bur. of Sport Fish. & Wildl., Fish Genetics Lab., Beulah, Wyoming 82712). 1972. INHERITANCE OF ALBINISM IN RAINBOW TROUT. J. Heredity, 63(3): 152-153.

Breeding tests conducted at the Fish Genetics Laboratory demonstrate that albinism in rainbow trout is a simple autosomal recessive character. No significant pleiotropic effect of the mutant gene was observed. (Authors summ.)

15320. Moore, Charles J., and Charles M. Frisbie (Benedict Estuarine Lab., Acad. of Natural Sciences, Pa., Benedict, Maryland 20612). 1972. A WINTER SPORT FISHING SURVEY IN A WARM WATER DISCHARGE OF A STEAM ELECTRIC STATION ON THE PATUXENT RIVER, MARYLAND. Chesapeake Science, 13(2): 110-115.

An interview-count sport fishing survey was conducted from January through April, 1970, along a one-mile discharge canal of the Potomac Electric Power Company's Steam Electric station located at Chalk Point, Maryland. An estimated 20,335 fishing trips, representing 77,943 hours of fishing, were made during the period sampled. On interview days, 8,758 fishermen were counted, and 4,716 were interviewed. An estimated 58,453 fish, representing 9 species, were taken, with an average of 0.71 fish caught per man-hour of effort. White perch, Morone americana, dominated the catch during all months sampled. No significant correlation could be made between water temperature of the canal and number of fish caught per man-hour of effort. (Authors)

15321. Zbigniew, Jara, Franciszek Markiewicz, and Tadeusz Bory Miaczynski. 1972. RESULTS OF INVESTIGATIONS ON THE STATE OF HEALTH OF THE TROUT IN LAKES OF THE TATRA NATIONAL PARK IN THE YEARS 1966-1970. (Wyniki badan zdrowotnosci pstragow w stawach Tatrzanskiego Parku Narodowego w latach 1966-1970). Acta Hydrobiol., 14(2): 129-141. In English.

Investigations on the state of health of the trout Salmo trutta morpha fario and Salmo fontinalis were carried out during a five-year period. The occurrence of parasites Raphidascaris acus (Bloch 1779), Neoechinorhynchus rutili (Müller 1870), Crepidostomum sp., Myxidium truttae, and Ichthyophonus intestinalis was detected. Moreover non-parasitic diseases were observed, such as a degeneration of the hepatopancreas (as a phenomenon occurring in masses in stream trout in the Lake Morskie Oko) and single cases of inflammation of the air-bladder, of a cyst in the excretory kidney, and of a goitre of the thyroid gland in spring trout in the Lake Zielony Staw Gasienicowy. (Authors)

15322. Dechtiar, Alex O. (Dept. of Lands and Forests, Res. Branch, Maple, Ontario, Canada). 1972. NEW PARASITE RECORDS FOR LAKE ERIE FISH. Great Lakes Fishery Comm., 1451 Green Rd., Ann Arbor, Mich. Technical Report No. 17, 20 p.

During 1961-1969 inclusive, 1,112 fish representing 46 species, were examined for parasites. Fish were taken mainly from the Port Dover area in the eastern end, and from the Wheatley area in the western end of Lake Erie. Ninety-six percent of the fish were infected by at least one species of parasite. This study adds 96 new records, including several new species, to the parasite fauna of Lake Erie fish, bringing the present known total to 215 species. (Auth.)

15323. Joy, James E. (Dept. of Veterinary Parasitology, Coll. of Vet. Medicine, Texas A&M Univ., College Station, Texas 77843). 1972. A NEW SPECIES OF Kudoa (MYXOSPORIDEA: CHLOROMYXIDAE) FROM THE SPOT, Leiostomus xanthurus Lacépède, IN CLEAR LAKE, TEXAS. J. Protozool., 19(2): 264-265.

Kudoa branchiata sp. n. (Myxosporidea: Chloromyxidae) is described from the gills of the marine sciaenid fish, Leiostomus xanthurus Lacépède, from Clear Lake, Texas. Twelve of the 429 hosts examined from 10 September 1970 to 28 April 1971, were infected. Eight of the 12 infected fish were collected in February and March 1971 - a period during which only 13% of the total host sample was taken. The mean total length of infected hosts was 149 mm, with a range of 112-185 mm. The mean number of myxosporidean cysts per infected host was 3.5, with a range of 1-11. (Auth.)

15324. Regier, Henry A., and Vernon C. Applegate (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1972. HISTORICAL REVIEW OF THE MANAGEMENT APPROACH TO EXPLOITATION AND INTRODUCTION IN SCOL LAKES. J. Fish. Res. Bd. Canada, 29(6): 683-692.

Though environmental deterioration and destruction has always concerned fishery biologists, much of their scientific and technical activities have been related to understanding and managing direct fisheries harvests, to "improving" fisheries resources through introductions of non-native species, and to assisting the reproductive process of valued stocks with a hatchery program. The history of these approaches in western countries is sketched by time periods as follows: pre-1840, gradually developing science and technology with intensifying direct exploitation; 1840-70, human food shortages in Europe, spreading of artificial propagation and development of hatchery and stocking techniques; 1870-1900, extensive introductions of non-native species, intensified exploitation because of technological advances and market forces, great expansion of artificial propagation; 1900-45, fluctuation in exploitation partly related to the socioeconomic aspects of world wars; 1945-60, conventional hatcheries closing, new fishing gear technology, more intense exploitation, growing concerns about pollution and eutrophication; 1960-70, "back to conservation" movement. (Authors)

15325. Nilsson, Nils-Arvid (Inst. of Freshwater Research, Drottningholm, Sweden). 1972. EFFECTS OF INTRODUCTIONS OF SALMONIDS INTO BARREN LAKES. J. Fish. Res. Bd. Canada, 29(6): 693-697.

There are still many lakes in the Palearctic that are barren of fish because of deglaciation history. Early transplantations of fish into such lakes have been documented, and there is a continuous activity of that kind going on for example in Scandinavia and at the North American west coast. Introductions of fish into barren lakes produce noticeable responses in the invertebrate fauna. For example, in a large mountain lake in northern Sweden the fairy shrimp Polyartemia forcipata disappeared after the introduction of Arctic char, and after a period of spectacular growth the fish now tend to get stunted. Changes in the invertebrate fauna after the introduction of new species of fish have been recorded also in many lakes with more complicated species compositions, and also in very large lakes such as Lake Michigan. In the Scandinavian mountain lakes there seems to be a correlation between the composition of fish species and the crustacean plankton. Further studies of introductions into barren lakes should provide a better understanding of predator-prey relations on the whole and, in the long run, of management of fish populations. (Auth.)

15326. Hartman, W. L., and R. L. Burgner (U. S. Bur. of Sport Fish. & Wildl., Biol. Sta., Sandusky, Ohio 44870). 1972. LIMNOLOGY AND FISH ECOLOGY OF SOCKEYE SALMON NURSERY LAKES OF THE WORLD. J. Fish. Res. Bd. Canada, 29(6): 699-715.

Many important, recently glaciated oligotrophic lakes that lie in coastal regions around the northern rim of the Pacific Ocean produce anadromous populations of sockeye salmon, Oncorhynchus nerka. This paper describes the limnology and fish ecology of two such lakes in British Columbia, five in Alaska, and one in Kamchatka. Then we discuss the following general topics: the biogenic eutrophication of nursery lakes from the nutrients released from salmon carcasses wherein during years of highest numbers of spawners, lake phosphate balances in Lakes Babine, Iliamna, and Dalnee are significantly affected; the use of nursery lakes by young sockeye that reveals five patterns related to size and configuration of lake basins and the distribution of spawning areas; the interactions between various life history stages of sockeye salmon and such resident predators, competitors, and prey as Arctic char, lake trout, Dolly Varden, cutthroat trout, lake whitefish, pygmy whitefish, pond smelt, sticklebacks, and sculpins; the self-regulation of sockeye salmon abundance in these nursery lakes as controlled by density-dependent processes; the interrelations between young sockeye salmon biomass and growth rates, and zooplankton abundance in Babine Lake; and finally, the diel, vertical, pelagial migratory behavior of young sockeye in Babine Lake and the new hypothesis dealing with bioenergetic conservation. (Authors)

15327. Smith, Stanford H. (U. S. Fish and Wildl. Serv., Great Lakes Fishery Lab., Ann Arbor, Michigan 48107). 1972. FACTORS OF ECOLOGIC SUCCESSION IN OLIGOTROPHIC FISH COMMUNITIES OF THE LAURENTIAN GREAT LAKES. J. Fish. Res. Bd. Canada, 29(6): 717-730.

Oligotrophic fish communities of the Great Lakes have undergone successive disruptions since the mid-1800s. Major contributing factors have been intensive selective fisheries, extreme modification of the drainage, invasion of marine species, and progressive physical-chemical changes of the lake environments. Lake Ontario was the first to be affected as its basin was settled and industrialized earliest, and it was the first to be connected by canals to the mid-Atlantic where the alewife (Alosa pseudoharengus) and sea lamprey (Petromyzon marinus) which ultimately became established in the Great Lakes were abundant. Oligotrophic fish communities were successively disrupted in Lakes Erie, Huron, Michigan, and Superior as the effects of population growth, industrialization, and marine invaders spread upward in the Laurentian drainage. The degree and sequence of response of families of fish and species within families differed for each factor, but the sequence of change among families and species has been the same in response to each factor as it affected various lakes at different times. The ultimate result of the disruption of fish communities has been a reduction of productivity of oligotrophic species that ranges from extreme in Lake Ontario to moderate in Lake Superior, and which has reached a state of instability and rapid change in the upper three Great Lakes by the mid-1900s similar to the situation in Lake Ontario in the mid-1800s. Since oligotrophic species (primarily salmonines, coregonines, and deepwater cottids) are the only kinds of fish that fully occupied the entire volume of the deepwater Great Lakes (Ontario, Huron, Michigan, and Superior), the fish biomass of these lakes has been reduced as various species declined or disappeared. In Lake Erie, which is shallow, and in the shallow bays of the deep lakes, oligotrophic species were replaced by mesotrophic species, primarily percids, which have successively increased and declined. All oligotrophic species are greatly reduced or extinct in lakes Ontario and Erie, and are in various stages of decline in lakes Huron, Michigan, and Superior, from greatest to least, respectively. The percids appear to be near the end of their sequence of succession in lakes Erie, Ontario, and Huron (primarily Saginaw Bay) where only the yellow perch (Perca flavescens) remains abundant. The yellow perch appears to be on the brink of decline in Lake Erie, which has been more severely influenced by water quality change than the other lakes. (Auth.)

15328. Johnson, Lionel (Fish. Res. Bd. of Canada Freshwater Inst., Winnipeg 19, Manitoba, Canada). 1972. KELLER LAKE: CHARACTERISTICS OF A CULTURALLY UNSTRESSED SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 731-740.

Keller Lake, with an area of 413 km^2, is an essentially unexploited lake in the Northwest Territories. Results of an experimental fishery and a commercial fishery of short duration are described. Effects of gillnet selection are discussed for the two major species, lake trout and humpback whitefish, and it is concluded that the sample obtained represents the actual population, at least for sizes over 350 mm in length. There were very few fish in the 350-500 mm size range, or in age-groups 9-13; but size and age were not closely correlated. The population structure is likened to a forest climax condition. A mechanism for the dynamics of the system is proposed, which can be tested. Size distribution of the population is considered to be in the form of a standing wave with the shape of a normal distribution for the main body of the population; age structure changes with time but will retain a bimodal condition continuously. The effect of cropping on a population structure of this type is discussed. (Auth.)

15329. U. S. Department of the Interior, Bureau of Sport Fisheries and Wildlife. (Washington, D. C. 20240). 1972. PROGRESS IN SPORT FISHERY RESEARCH 1970. U. S. Dept. of the Interior, Bur. of Sport Fish. & Wildl., Division of Fishery Research Resource Publication 106, 318 p. For sale by Supt. of Documents, U. S. Govt. Printing Office, Washington, D. C. 20402 - Price $2.25.

15330. Keleher, J. J. (Dept. of Mines, Resources, and Environ. Management, Winnipeg, Manitoba R3C OP8, Canada). 1972. GREAT SLAVE LAKE: EFFECTS OF EXPLOITATION ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 741-753.

A 20-year investigation commenced at the inception of the Great Slave Lake commercial fishery, and it is inferred that exploitation has been the sole cause of change in the fish stocks. Background information on the operation of the commercial fishery, the fishing regulations, and the study methods are provided. Lake whitefish, Coregonus clupeaformis, and lake trout, Salvelinus namaycush, have made up 94% of the commercial landings of 119 million lb during the period. Only three other species of the 25 occurring in the lake were usually marketed. Whitefish catches generally were distributed equally between the summer and winter seasons. Trout were caught almost exclusively during the summer season. The annual catch of these two species rose from 1.6 million lb in 1945 to a maximum of 9.4 million lb in 1949 than gradually decreased to about the 5 million lb level. The study data have been partitioned according to 13 statistical areas. Catch has not been in proportion to the extent of these areas. Whitefish catch has predominated in the western, Interior Lowlands, portion of the lake while trout catch has predominated in the eastern, Canadian Shield, portion. In various areas, the peak catches for whitefish were associated with peak catches for trout, indicating that both were the result of fishing down the virgin stocks. Summer catch per unit effort for each species has declined during the 20-year period. CPE varied with the statistical areas. The usual observed reduction for whitefish was 60% in contrast to 93% for trout. Estimated summer fishing effort and whitefish catch showed a direct relation but the relation for trout usually changed from a positive to a negative one. The average size of commercially caught fish has declined to about 2 lb for whitefish and 5 lb for trout. Information on catch per unit effort for other species indicates no evident explosions in their numbers, though ciscoes, Leucichthys spp., appear to have increased in abundance. Although the fishery was regulated in order to provide for maximum annual sustained yields, this has not been achieved for trout. Three opinions for this are offered. Exploitation under a pooled quota system for whitefish and trout is not favoured and a decrease in trout quota is recommended. (Auth.)

15331. Roth, H., and W. Geiger (Fischereiinspektorat des Kantons Bern, Bern, Switzerland). 1972. BRIENZERSEE, THUNERSEE, AND BIELERSEE: EFFECTS OF EXPLOITATION AND EUTROPHICATION ON THE SALMONID COMMUNITIES. J. Fish. Res. Bd. Canada, 29(6): 755-764.

These three lakes of the Aare Valley in Switzerland have been subjected to increasingly intense fisheries exploitation in recent decades. Fishing intensities have been roughly comparable in the three lakes in any particular year. Attempts at introducing non-native species have been made in all lakes but none of the attempts have had appreciable effect. Nutrient loading, due to domestic wastes predominantly, has been much greater with the downstream Bielersee than the upper two lakes, and somewhat greater in the Thunersee than the highest lake, Brienzersee. But even the latter is now showing symptoms of nutrient stress, in that populations of indicator phytoplankters have recently erupted. Ecological effects ascribed to the fishery include a marked reduction in stocks of Arctic char due to angling and pelagic coregonines due to commercial gillnetting. The latter taxa have recently shown pronounced fluctuations in year-class abundance. An energetic hatchery program has mitigated exploitation effects to some extent. Total stocks of fishes have increased due to eutrophication with initial increases in all fish taxa, except perhaps Arctic char. The cyprinids, percids, and esocids have increased in the Bielersee to a far greater extent than the salmonids with a result that the latter are now contributing smaller proportions of the catches. The cyprinids have little economic value and their burgeoning stocks are creating ecological and economic problems in the Bielersee as well as many other Swiss lakes. The cyprinids apparently cannot be effectively controlled by piscivores such as esocids, even where the latter are assisted by a hatchery program. (Authors)

15332. Lawrie, A. H., and J. F. Rahrer (Ont. Dept. of Lands and Forests Res. Branch, Maple, Ontario, Canada). 1972. LAKE SUPERIOR: EFFECTS OF EXPLOITATION AND INTRODUCTIONS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 765-776.

Lake Superior is highly oligotrophic and not very productive. It has not, however, been much affected by man's activities. Substantial quantities of woody allochthonous materials entered the lower reaches of tributaries and their estuaries from the pioneer lumbering industry. These undoubtedly depreciated the shallow-water benthic environment and may have adversely affected fish stocks in the immediate areas concerned, especially those of lake sturgeon (Acipenser fulvescens) and lake whitefish (Coregonus clupeaformis). At present, local areas of urban or industrial pollution can be identified but, in general, appear to have had little adverse effect on fish stocks, although the collapse of one walleye stock has been attributed to pollution from a paper mill. Every commercial species has, however, been severely depleted. Recent declines can be correlated with predation by sea lamprey (Petromyzon marinus) but, without exception, all species give evidence of extensive overfishing long before sea lamprey entered the lake. That this has not been more obvious is due to the stratification of catch statistics by arbitrary geographic areas (statistical districts) which are too large to relate meaningfully to either fish distributions or patterns of fishery operations. Because fish are generally distributed as local, often small, quasi-discrete stocks, they were exploited sequentially by the young, developing fishery. In this way stock after stock was depleted while conventional yield statistics gave an impression of relative stability. The lag before these statistics indicated the decline appears to be related to the degree of dispersal characteristic of each species. Thus the decline of the sturgeon was first evident, that of the lake trout (Salvelinus namaycush) last. Recovery has been slight but modern hatchery technology clearly provides a prospect for rejuvenating existing stocks or developing new ones. In either case, such synthetic populations will offer favorable opportunities for detailed investigation of the nature of fish distribution and its bearing on the interpretation of catch statistics. (Authors)

15333. Grimaldi, Ettore (Istituto Italiano di Idrobiologia, Pallanza, Italy). 1972. LAGO MAGGIORE: EFFECTS OF EXPLOITATION AND INTRODUCTIONS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 777-785.

Lake trout (Salmo trutta) is the only salmonid belonging to the original fish fauna of Lago Maggiore (north Italy): the coregonine "lavarello" (Coregonus sp.) was introduced into it in 1891, char (Salvelinus alpinus) in 1910, and the coregonine "bondella" (Coregonus macrophthalmus) in 1950. This last introduction heavily affected the preexisting population of fish, bringing about the almost complete disappearance of both "lavarello" and char. The increase of human population within the watershed, as well as the modified pattern of its distribution, seem to have played a major role in speeding up the trophic evolution of Lago Maggiore during recent years. However, as far as fish is concerned, it is very difficult to distinguish changes really due to eutrophication from those attributable to other human interventions, such as introductions of exotics, destruction of spawning grounds in the main tributaries, alterations in shore structure, and very heavy fishing pressure on pelagic as opposed to littoral fish. (Auth.)

15334. Youngs, William D., and Ray T. Oglesby (Dept. of Natural Resources, Cornell Univ., Ithaca, New York 14850). 1972. CAYUGA LAKE: EFFECTS OF EXPLOITATION AND INTRODUCTIONS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 787-794.

Cayuga Lake, a glacially formed, warm monomictic lake in New York State, has an area of 172.1 km^2 and a mean depth of 54.5 m. It now exhibits qualitative signs of eutrophication in phytoplankton composition and aquatic vegetation. However, hypolimnetic oxygen depletion has not changed to any great extent over the last fifty years. Early commercial fisheries were for nonsalmonid species. Whitefish have apparently never been common in the lake, though cisco have at times been abundant. In recent times the lake and rainbow trouts have provided an appreciable sport fishery. The lake trout population is maintained by annual stocking at a level that provides good sport fishing. Natural population is maintained

by annual stocking at a level that provides good sport fishing. Natural reproduction is not successful for lake trout, presumably due to siltation of spawning areas. Introduced species appear to have caused some changes in the native fish community. The alewife appears to have replaced the cisco and now is the major forage species in the lake. Other important introductions include the smelt and the sea lamprey. The salmonine populations were built up despite the presence of sea lamprey. Life history information on other species common in the lake is presented. (Authors)

15335. Martin, N. V., and F. E. J. Fry (Ont. Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1972. LAKE OPEONGO: EFFECTS OF EXPLOITATION AND INTRODUCTIONS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 795-805.

Lake Opeongo, a 58.6 km^2 lake in the highlands of Algonquin Park, Ontario, has been under study since 1936. Due to little human development of the area, environmental conditions have been stable but because of its geological setting and location the lake waters are relatively unproductive. The smallmouth bass introduced in 1928 has had no apparent major impact on the salmonid community but has served to buffer fishing pressure on the lake trout. The cisco introduction in 1948 resulted in faster growing, better conditioned, and more fecund lake trout but has also contributed to their later maturity. Weight production of trout increased and in recent years stronger classes have apparently resulted from the improvement in fecundity. Declines in the perch and benthic insects and a decrease in growth rate of certain fishes since the mid-1950s are apparently related to the cisco introduction. Harvest of lake trout by the sport fishery has varied from 630 to 2700 fish/year representing a long term yield of 0.33 kilos/ha. Mean total mortality rate is 50%/year and exploitation has served to double the mortality rate after the trout have entered the fishery. Year-class production is correlated with spawning escapement and exploitation has limited recruitment to the trout population. (Authors)

15336. Grimås, Ulf, Nils-Arvid Nilsson, and Curt Wendt (Environ. Protection Bd. Research Lab., Drottningholm, Sweden). 1972. LAKE VÄTTERN: EFFECTS OF EXPLOITATION, EUTROPHICATION, AND INTRODUCTIONS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 807-817.

Vättern, the second largest lake of Sweden, contains 28 species of fish, of which Arctic char (Salvelinus alpinus) and whitefish (Coregonus spp.) are the most important economically. There is both a commercial fishery and a sport fishery. The former has decreased steadily, while the latter is increasing. A modest eutrophication is occurring, due amongst other factors to an increasing input of phosphorus and resulting, for instance, in a decrease in transparency. The lake is, however, still to be characterized as typically oligotrophic. The input of polluting matters is alarming, especially as regards toxic substances. Exploitation of fish populations has on the whole increased, although the number of commercial fishermen decreases. The fishery on the char population and military activity may in the long run result in over-exploitation. An inverse correlation between the catches of char and whitefish has been explained as a result of interaction between the two species. An obvious increase in catches of the Coregonus species (whitefish and cisco) is taken to be the result of eutrophication. Introductions of "exotic" species have only resulted in one recorded case of reproduction of rainbow trout (Salmo gairdneri). Several promising experiments with the release of hatchery-reared fish, e.g. landlocked salmon (Salmo salar), have been carried out. Growth rate of several fish species in Vättern has appeared to be faster than normal. (Authors)

15337. Le Cren, E. D., Charlotte Kipling, and Jean C. McCormack (Freshwater Biol. Assoc., The Ferry House, Ambleside, Westmorland, England). 1972. WINDERMERE: EFFECTS OF EXPLOITATION AND EUTROPHICATION ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 819-832.

Windermere is a lake of 14 km^2 divided into two glacially excavated basins. It is essentially mesotrophic but, about 1840, Asterionella became the dominant planktonic diatom and small changes towards eutrophication have recently occurred,

all as a result of increases in population, water borne sewage, and agricultural fertilization in the catchment. Windermere has five salmonid taxa belonging to the three species: Salmo salar, S. trutta, and Salvelinus willughbii. Perca fluviatilis, Esox lucius, Anguilla anguilla, and Phoxinus phoxinus are abundant, and there are two other small fish species. A successful net fishery for the char, perch, pike, and trout operated for several centuries until overfishing for the char and an ascending interest in sport fishing for salmon and trout brought it to an end in 1921. There was then no significant exploitation until 1941. The Freshwater Biological Association has experimented with the fish populations since 1941 by intensive trapping of perch from 1941 to 1964 and gillnetting of pike from 1944 to the present. Perch were reduced to less than 20% of their former abundance and have not recovered since trapping ceased; their growth rate has increased. The larger pike have been reduced but young pike are more numerous. Char have increased. Most of the population changes of these three species can be attributed to pike netting, but fluctuations caused by variations in year-class strength contribute. The recent establishment of small local populations of Rutilus rutilus, Scardinius erythrophthalmus, and Tinca tinca are probably the only effects on the fish of slight eutrophication. (Authors)

15338. Nümann, W. (Inst. für Seenforschung und Seenbewirtshaftung Langenargen/Bodensee, Germany). 1972. THE BODENSEE: EFFECTS OF EXPLOITATION AND EUTROPHICATION ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 833-847.

The upper basin or Obersee of the Bodensee still retains all the fish species described more than four centuries ago, though rapid changes have recently been noted in many aspects of the fish community and of the Bodensee ecosystem. Though a variety of non-native species have been introduced, including a number of European and North American salmonids, none has become a prominent part of the community. The famous Blaufelchen, a pelagic coregonine, has recently been threatened by a combination of increasingly intensive exploitation, beginning at a low minimum size, compounded by an increasing growth rate of the species due to low population density, and due to increased planktonic food as a result of eutrophication. Consequently, by the early 1960s, the fishery came to exploit large yearlings, and few Blaufelchen survived to spawn. Eutrophication has reached a stage that is marginal to a number of deeper, benthic coregonines and char. Cyprinids, usually inshore, have expanded greatly, have invaded the pelagic habitat, and are subject to periodic mass mortalities. Other of man's effects are identified as are management measures now in practice. (Auth.)

15339. Maitland, Peter S. (The Nature Conservancy, Edinburgh, Scotland). 1972. LOCH LOMOND: MAN'S EFFECTS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 849-860.

Loch Lomond, the largest area of fresh water in Great Britain, has been utilized by man for many hundreds of years. There are fifteen species of fish at present in the loch: all of these are native. Several of them have formed the basis of commercial and sport fisheries in the past but the only two species of importance at present (as sport fish) are salmon (Salmo salar) and trout (Salmo trutta). Man has influenced the loch in ways other than fishing: several fish species have been introduced (none successfully); nutrient input is increasing; loch water is used for domestic and industrial supply; many forms of recreation take place on the loch; and it is of major importance as an amenity. In spite of these stresses there is no indication of any major change in the fish populations within recorded time; nor is there any evidence that they will alter in the foreseeable future, providing a rational conservation programme is developed for the area. (Auth.)

15340. New York State College of Agriculture, Cornell University (Ithaca, New York). 1968. ASPECTS OF PLANNING, EVALUATION & DECISION-MAKING IN SPORT FISHERY MANAGEMENT. Dept. of Conservation Extension Series No. 1, 23 p. From Fourth New York Fishery Biologists' Seminar, Ithaca, N. Y., March 28, 1968.

15341. Northcote, T. G. (Dept. of Recreation and Conservation, Fish and Wildl. Branch and Inst. of Animal Resource Ecology, Univ. of Br. Columbia, Vancouver, British Columbia, Canada). 1972. KOOTENAY LAKE: MAN'S EFFECTS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 861-865.

A synopsis and evaluation is made of man's impact on Kootenay Lake salmonids since their first significant contact, perhaps less than 300 years ago. Exploitation of stocks for food by native Kootenay Indians was heavy in the late 1700s, probably surpassing present sport-fishery exploitation estimated at about 35 tons annually. Exploitation for fish-culture purposes never exceeded 7 tons annually, but because of restriction to a few spawning streams had serious effects on some local populations. Introduction of non-native fishes apparently was of little consequence to salmonids, whereas mysid introduction probably has produced growth enhancement in some stocks, especially kokanee. A similar but less obvious effect may be due to the marked cultural eutrophication occurring via heavy phosphate enrichment from a fertilizer plant. More serious and deleterious changes have been effected by stream habitat alteration resulting from mining, agriculture, and logging practices as well as from dam construction. (Auth.)

15342. Laurent, P. J. (Station D'Hydrobiologie Lacustre, Thonon, France). 1972. LAC LEMAN: EFFECTS OF EXPLOITATION, EUTROPHICATION, AND INTRODUCTIONS ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 867-875.

Review of 14 years of data concerning the geographic and hydrographic characteristics of Leman show that this lake is in the process of eutrophication: nutrient levels are increasing, oxygen levels are decreasing in the deep waters, and the algal flora has changed. The effect of the current warming of the climate on its evolution is taken into consideration. Since 1900 the fishing regulations of the Swiss and French have been dissimilar. Excessively small size limits and at certain times the abusive use of nets have repeatedly led to a reduction of the most valued species. French catch data, covering more than 70 years, reveal fluctuations which reflect biological disturbances due primarily to overexploitation and also to eutrophication. Landings have increased but value has decreased. Numerous introductions have been made purposely or accidentally. Certain of these species have had deleterious effects (sticklebacks) and some beneficial (introductions of a new population of coregonines after the extinction of the indigenous species). Some aspects of the biology of the most valued salmonids (Salmo trutta, Salmo gairdneri, Salvelinus alpinus) have been shown as well as the results of attempts to repopulate them using pisciculture and marking. Plantings of rainbow trout along the shoreline during summer gave best results (percentage return and growth being most important), although their reproduction seems to be doubtful. Overexploitation of coregonines followed by that of perch (Perca fluviatilis) has left roach (Rutilus rutilus) to inhabit all the central zone of the lake. This valueless species is favored by eutrophication and is thus able to utilize plankton without undergoing competition from coregonines and young perch, or predation by larger perch. No fishing profits are derived from the invasion of the lake by roach. (Auth.)

15343. Berst, A. H., and G. R. Spangler (Ont. Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1972. LAKE HURON: EFFECTS OF EXPLOITATION, INTRODUCTIONS, AND EUTROPHICATION ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 877-887.

Lake Huron is a large, deep, oligotrophic lake, centrally located in the St. Lawrence Great Lakes system. Manitoulin Island and the Bruce Peninsula divide the lake into the relatively discrete water masses of the North Channel, Georgian Bay, and Lake Huron proper. Water quality in Lake Huron has deteriorated only slightly since the early 1800s. The only significant changes are confined to areas adjacent to centers of human activity, chiefly Saginaw Bay and various harbors and estuaries in Georgian Bay and the North Channel. The lake has supported a commercial fishery which has produced annual catches as high as 13,000 metric tons. A dramatic decline in landings of commercially valuable species and an instability in fisheries resources has occurred in all areas of the lake since the 1940s. This depression of populations of valued species was associated with the

accidental introduction of the sea lamprey, instances of overfishing and deterioration of water quality in Saginaw Bay. The present depressed state of the fisheries will undoubtedly persist until sea lamprey control is achieved and climax predators are reestablished. Governments are proceeding toward the establishment of water quality criteria and fishery management practices which, hopefully, will stabilize the fisheries and prevent further deterioration of the aquatic environment. (Authors)

15344. Wells, LaRue, and Alberton L. McLain (Bur. of Sport Fish. & Wildl., Great Lakes Fishery Lab., Ann Arbor, Michigan 48107). 1972. LAKE MICHIGAN: EFFECTS OF EXPLOITATION, INTRODUCTIONS, AND EUTROPHICATION ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 889-898.

Lake Michigan surface area is 22,400 square miles and its main depth is 276 ft. Its fauna is generally typical of North American oligotrophic lakes. The original fish populations included 10 coregonines and one salmonine. The lake whitefish, the lake herring, and the lake trout were most abundant. Man's activities have caused great changes in the lake in the past 120 years. Although changes in water chemistry and in the lower biota have been generally modest (except locally), those in salmonid communities have been vast. Exploitation, exotic fish species (especially the sea lamprey and alewife), and accelerated eutrophication and other pollution, all have played a role in bringing about the modifications (mostly marked declines in abundance) in salmonid communities. Commercial exploitation was largely responsible for the changes in the salmonid communities before the invasion of the lamprey (1936), although eutrophication and other pollution, and alterations of spawning streams, also were important. The lamprey and alewife (first reported in 1949), however, have exerted a greater impact than the other factors in recent decades. (Authors)

15345. Hartman, W. L. (U. S. Bur. of Sport Fish. & Wildl., Biol. Sta., Sandusky, Ohio). 1972. LAKE ERIE: EFFECTS OF EXPLOITATION, ENVIRONMENTAL CHANGES AND NEW SPECIES ON THE FISHERY RESOURCES. J. Fish. Res. Bd. Canada, 29(6): 899-912.

In no other lake as large as Lake Erie (surface area, 25,690 km^2) have such extensive changes taken place in the drainage basin, the lake environment, and the fish populations over the last 100 years. Deforestation and prairie burning led to erosion and siltation of valuable spawning grounds. Marsh spawning areas were drained. Lake-to-river spawning migrations were blocked by mill dams. Accelerated cultural nutrient loading increased total dissolved solids by nearly 50% (1920-70). Average summer water temperatures increased 1.1 C. Phytoplankton and zooplankton abundance increased severalfold. Severe oxygen depletion developed in the bottom waters of all three basins of the lake. Lake sturgeon were fished out as a nuisance fish in the late 1800s. The commercial fisheries for lake trout, lake whitefish, and lake herring collapsed by 1940 and those for blue pike and walleye by 1960. Yellow perch production became unstable in the 1960s. The effects of exploitation, environmental changes, and new species on these fish population changes are discussed. (Auth.)

15346. Grimaldi, E., and W. Nűmann (Istituto Italiano di Idrobiologia, Pallanza, Italy). 1972. THE FUTURE OF SALMONID COMMUNITIES IN THE EUROPEAN SUBALPINE LAKES. J. Fish. Res. Bd. Canada, 29(6): 931-936.

Eutrophication is the main danger threatening European subalpine lakes, particularly the small ones. Among salmonids, char seems already to have suffered severely from organic pollution, and may fare even less well in future, though forecasts are less pessimistic for trout and coregonines. Building of industries and power plants, tampering with shores, shipping and hydrologic and hydrographic changes must be opposed if these bodies of water are to be preserved in ecologically healthy states. The future of fisheries largely depends on commercial and socio-economic factors. (Authors)

15347. Christie, W. J. (Ont. Dept. of Lands and Forests, Glenora Fish. Station, Picton, Ontario, Canada). 1972. LAKE ONTARIO: EFFECTS OF EXPLOITATION, INTRODUCTIONS, AND EUTROPHICATION ON THE SALMONID COMMUNITY. J. Fish. Res. Bd. Canada, 29(6): 913-929.

Commercial catch statistics were analyzed to follow the sequence of events in the deterioration of the major fish stocks of Lake Ontario. Atlantic salmon (Salmo salar), lake trout (Salvelinus namaycush), burbot (Lota lota), deepwater ciscoes (Coregonus sp.), and whitefish (Coregonus clupeaformis) have all disappeared or declined seriously in abundance. Only the colonists alewife (Alosa pseudoharengus), smelt (Osmerus mordax) and white perch (Morone americana) are currently abundant. Abundance of deepwater ciscoes is thought to have been controlled originally by the piscivores lake trout and burbot. Three deepwater cisco species are inferred to have been progressively eliminated by overfishing, leaving only the smallest and least valuable present when the fishery collapsed. The effects of the sea lamprey (Petromyzon marinus) on the Lake Ontario fishes are held to have increased with the reduction of the number of dams in the watershed, and as fishing reduced numerical abundance and average size of the prey fishes. The early colonists alewife and carp (Cyprinus carpio) were thought to have stabilized early. It was suggested smelt were suppressed for many years by trout and burbot predation, and after the release of this constraint, the smelt in turn caused the collapse of the deepwater ciscoes and other species through predation. The white perch invasion of the Bay of Quinte was thought particularly swift and successful because of the absence of predators. Yellow perch (Perca flavescens) abundance may have increased because of eutrophication effects in the nearshore areas. Recent deterioration of water quality appears so extreme as to ensure that the last premium species which used the inshore areas cannot return. Overfishing is thought to have been the major destabilizing influence. The role of the open lake predators in the vectoring of energy and materials through the system is discussed. (Auth.)

15348. Grimås, Ulf, Nils-Arvid Nilsson, Jorma Toivonen, and Curt Wendt (Environ. Protection Bd., Research Lab., Drottningholm, Sweden). 1972. THE FUTURE OF SALMONID COMMUNITIES IN FENNOSCANDIAN LAKES. J. Fish. Res. Bd. Canada, 29(6): 937-940.

In trying to make predictions for the future of the Fennoscandian lakes it is difficult to disregard the obvious threat of a common protein deficiency in the world population. At the moment, however, there is a trend in the fishery away from a commercial and subsistence gillnet fishery towards a use of the lakes for recreational purposes. Eutrophication induced by man is proceeding everywhere, although governmental authorities are aware of this threat. In some large lakes the process may have reached an optimum where it is still favoring production of relatively large yields of some important species of fish. Exploitation of some species, for example salmonids and sander, is in some cases overly intensive, but is not yet regarded as a serious problem. Introductions of "exotic" species have had little influence on native stocks. The release of hatchery-reared landlocked salmon, rainbow trout, and lake trout will hopefully raise the value of the fishery in some lakes in the future. Pollution by toxic substances such as mercury, DDT, and PCB, and the fall-out of SO_2 from the atmosphere, are at present the most serious threats to the fishery. (Authors)

15349. Ryder, R. A., and L. Johnson (Ont. Dept. of Lands and Forests, Fish. Res., Thunder Bay, Ontario, Canada). 1972. THE FUTURE OF SALMONID COMMUNITIES IN NORTH AMERICAN OLIGOTROPHIC LAKES. J. Fish. Res. Bd. Canada, 29(6): 941-949.

Predictions are made pertaining to the status of salmonid communities in North American oligotrophic lakes about the year 2000. It is assumed that man-induced effects such as eutrophication, exploitation, and introduction of exotic species will continue to increase at an exponential rate. The influence of forest fires, domestic and industrial water pollution, road development, pulp mills, mines, pipe-lines, air pollution, agriculture, power development, summer resorts, angling, commercial and subsistence fishing, diversions and introductions of both salmonids and other species is discussed. It is concluded that at the present

rate of interference of the oligotrophic environment by man, salmonid communities will be reduced to insignificant levels within the next 30 years. (Authors)

15350. Smith, Stanford H. (U. S. Fish & Wildl. Serv., Great Lakes Fishery Lab., Ann Arbor, Michigan 48107). 1972. THE FUTURE OF SALMONID COMMUNITIES IN THE LAURENTIAN GREAT LAKES. J. Fish. Res. Bd. Canada, 29(6): 951-957.

The effects of human population growth, industrialization and the introduction of marine fishes have reduced the suitability of each of the Great Lakes for oligotrophic fish communities. The ultimate consequence has been a reduction of fishery productivity that has ranged from extreme in Lake Ontario to moderate in Lake Superior. If measures are not taken to alleviate the adverse effects of marine invaders and trends in environmental quality, a major reduction in fishery productivity can eventually be expected throughout the Great Lakes. Prospects for the next century will be improved if the lakes can be intensively managed. More stringent control of the sea lamprey (Petromyzon marinus), and subsequent reduction of the alewife (Alosa pseudoharengus), by the reestablishment of populations of large piscivores, should permit the recovery of some of the previous predator and prey species, or the development of populations of new species that are more compatible with a reduced number of lampreys. Even if marine species can be reduced greatly, the full restoration of the former fishery productivity remains uncertain and will require a high degree of coordination among all management and research agencies that have responsibilities on the Great Lakes. Unfavorable trends toward progressive degradation of water quality pose the greatest threat to restoration of the fishery resources of the Great Lakes. Where changes in water quality have been the greatest, oligotrophic species have become scarce or absent, and in the deepwater regions no other species have reoccupied the vacated niches. (Auth.)

15351. Regier, Henry A., and Kenneth H. Loftus (Ramsay Wright Labs., Univ. of Toronto, Toronto, Ontario, Canada). 1972. EFFECTS OF FISHERIES EXPLOITATION ON SALMONID COMMUNITIES IN OLIGOTROPHIC LAKES. J. Fish. Res. Bd. Canada, 29(6): 959-968.

In many oligotrophic lakes intense fisheries exploitation preceded severe cultural eutrophication by several decades at least, except perhaps in stream and inshore areas near shore. Attempts to infer the effects of exploitation from historical fisheries data must allow for the high rates of capture associated with the "fishing-up" process that follows initiation of a new fishery, introduction of a new gear, change in capture or vessel technology, etc. The nature of the fishing-up process is examined in some detail. Interactions of new species introduction and of eutrophication with exploitation are outlined. Within the salmonids, different taxa appear to respond somewhat differently to exploitation stress. Some taxa appear to have greater capabilities to compensate for this stress than others. Responses of the taxa are examined in the context of well-known properties of their niches and population variables. Some inferences concerning responses at the community level are proposed. Compensatory capabilities seem directly related to the degree of eutrophy of the lake. Events such as the virtual disappearance of taxa, or eruptions of new taxa, and the relative variability in year-class abundance of dominant taxa, are examined in this context. (Authors)

15352. Christie, W. J., J. M. Fraser, and S. J. Nepszy (Ont. Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1972. EFFECTS OF SPECIES INTRODUCTIONS ON SALMONID COMMUNITIES IN OLIGOTROPHIC LAKES. J. Fish. Res. Bd. Canada, 29(6): 969-973.

Adequate documentation was often wanting for interpretation of conditions surrounding the success or failure of an exotic. There were also known differences in species composition and other circumstances which made comparisons between SCOL lakes difficult. Successful colonization appeared possible where a sufficiently plastic new species found a niche either temporarily or permanently void. The lack of normal ecological constraints favored the explosion of a colonist, and examples were found which indicated both physiological and behavioral adaptation to permit establishment. The data suggested predation may be important in suppressing invaders. The higher diversity of littoral fish communities provided greater

resistance to colonists. The role of exploitation in the fate of any colonist seemed chiefly in its effect on diversity and on stock oscillations. Eutrophication favored the success of colonists through continued destabilization of communities. It was suggested that management should proceed towards greater diversity to minimize the chances of outbreaks of pest fishes. (Authors)

15353. Colby, P. J., G. R. Spangler, D. A. Hurley, and A. M. McCombie (Ont. Dept. of Lands and Forests, Research Branch, Maple, Ontario, Canada). 1972. EFFECTS OF EUTROPHICATION ON SALMONID COMMUNITIES IN OLIGOTROPHIC LAKES. J. Fish. Res. Bd. Canada, 29(6): 975-983.

Oligotrophic lakes respond to progressive eutrophication by a sequence of predictable events. Increased nutrient loads and subsequent increased plant production result in alterations in the abiotic environment, including changes in the color and transparency of the water, increased turbidity, oxygen depletion in the hypolimnion, and increased chemical stratification. The physico-chemical changes precipitate biotic changes among the phytoplankton, littoral algae, zooplankton, and benthos. The salmonid community may respond initially with an increased body growth rate in various taxa and a higher incidence of parasitism, but later inhibition of natural reproduction occurs, and finally, the taxa are replaced by others that can survive in the changed environment. A relation between natural nutrient loading (expressed in terms of a morphoedaphic index) and yield (both quantitative and qualitative) is proposed as an aid to determining the natural successional status of a lake. Knowing the natural baseline of a particular lake the fisheries managers can judge the nature and size of responses due to cultural nutrient loading and then alter the rate of cultural nutrient loading to modify the ecological effects, or they can use biological engineering to capitalize on the present conditions. Among the most important effects of eutrophication is the increased vulnerability of sedentary discrete stocks to changes in other stresses such as fishing. (Authors)

15354. Motais, R., and J. Isaia (Lab. de Physiologie Cellulaire et Groupe de Biologie Marine du C.E.A., Faculte des Sciences de l'Universite de Nice 06, Nice, France). 1972. TEMPERATURE-DEPENDENCE OF PERMEABILITY TO WATER AND TO SODIUM OF THE GILL EPITHELIUM OF THE EEL Anguilla anguilla. J. Exp. Biol., 56(3): 587-600.

The temperature dependence of diffusional permeability to water was studied in freshwater-adapted and seawater-adapted eels. The pattern of temperature acclimation is discussed. The ratio of water permeability to sodium permeability is approximately 3 at 25°C, but falls to 1 at 5°C. This drop is mainly due to a diminution of the water permeability, the temperature coefficients being much higher for water than for sodium. The relatively independent variations of water and sodium permeabilities in the seawater-adapted fish probably indicate a certain dissociation between water movements and salt movements. In the freshwater-adapted eel the osmotic permeability is considerably higher than the diffusional permeability, which supports the previously advanced hypothesis concerning the presence of water-filled channels in the branchial epithelium. In the seawater-adapted eel the osmotic permeability is lower than the diffusional permeability, this difference being greater the lower the temperature. This surprising result must signify either that the osmotic pressure difference between blood and sea water does not represent the true osmotic gradient across the membrane, or that a reabsorption of water linked with a movement of solutes occurs in a specialized region of the gill. (Authors summ.)

15355. Hunt, P. C., and J. W. Jones (Dept. of Zool., Univ. of Liverpool, England). 1972. TROUT IN LLYN ALAW, ANGLESEY, NORTH WALES. I. POPULATION STRUCTURE AND ANGLING RETURNS. J. Fish Biol., 4(3): 395-408.

An account is given of the survival and contribution to sport fishing of stocked trout and natural river trout in the impounded reservoir, Llyn Alaw, in Anglesey, North Wales. Scales from 2143 trout caught by angling and netting during the first four years after impoundment were used to determine the age and origin of Llyn Alaw fish. The success and future of Llyn Alaw as a trout fishery are discussed. (Authors)

15356. Metcalf, F. A., G. S. Whitt, and W. F. Childers (Dept. of Zool., Univ. of Ill., Urbana, Illinois 61801). 1972. INHERITANCE OF ESTERASES IN THE WHITE CRAPPIE (Pomoxis annularis), BLACK CRAPPIE (P. nigromaculatus), AND THEIR F_1 AND F_2 INTERSPECIFIC HYBRIDS. Anim. Blood Grps biochem. Genet., Vol. 3, pp. 19-33.

White crappie, Pomoxis annularis, and black crappie, P. nigromaculatus, were hybridized to produce F_1 and F_2 generations. There was considerable tissue specific esterase gene function within each parental species. Many of the esterases were homologous but possessed different electrophoretic mobilities between the two species which permitted their use as gene markers. The pattern of inheritance and expression of a number of esterase genes was determined in the F_1 and F_2 interspecific hybrids. Although certain key morphological phenotypes characteristic of the black crappie predominate in the F_1 hybrid, the enzyme phenotypes reflect the contributions of both co-dominant parental genomes. There is a higher percentage of heterozygotes than expected in the F_2 generation which may be indicative of heterosis. The genetic analysis also provided a better understanding of the polypeptide composition of these esterases. (Authors summ.)

15357. Potts, W. T. W., and P. P. Rudy (Oregon Inst. of Marine Biol., Univ. of Oregon, Charleston, Oregon 97420). 1972. ASPECTS OF OSMOTIC AND IONIC REGULATION IN THE STURGEON. J. Exp. Biol., 56(3): 703-715.

Analyses have been made of the blood and urine of the euryhaline sturgeon Acipenser medirostris and the rates of turnover of sodium and water in both sea water and fresh water have been measured. The blood concentration is rather lower in fresh water than in sea water and the concentration of magnesium ions declines markedly. The rate of turnover of sodium ions is high in sea water and similar to that of marine teleosts. The rate of turnover of sodium is much lower in fresh water but adaptation to fresh water is slow and the animals are more permeable to sodium than are teleosts. The rate of turnover of tritiated water is more rapid in fresh water than in sea water but in each medium it is similar to that of teleosts of a similar size. (Authors summ.)

15358. Leatherland, J. F. (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1972. HISTOPHYSIOLOGY AND INNERVATION OF THE PITUITARY GLAND OF THE GOLDFISH, Carassius auratus L.: A LIGHT AND ELECTRON MICROSCOPE INVESTIGATION. Can. J. Zool., 50(6): 835-844.

Six secretory cell types (prolactin-, ACTH-, somatotropin- (STH-), TSH-, and two presumptive gonadotropin- (GTH-) secreting cells) were identified in light or electron microscope preparations of goldfish pars distalis. A further two cell types of unknown function were demonstrated in the pars intermedia. Cellular identification was based on the position of cells within the adenohypophysis and on the staining properties or morphological characteristics of the cytoplasmic granules. The prolactin-, ACTH-, and STH-secreting cells and the pars intermedia cells appeared to release granules into the basement membrane whereas granule release from TSH- and GTH-secreting cells was not found. Many of the adenohypophysial cell types were innervated directly or across a basement membrane by B-type neurohypophysial fibers. A-type necrosecretory fibers were associated with blood vessels and pituicytes within the neurohypophysis. The possible role(s) of the two types of pituicytes is discussed. (Auth.)

15359. Scholl, A., and H. M. Eppenberger (Zoologisches Institut der Universität, Sahlistrasse 8, 2012 Bern, Switzerland). 1972. PATTERNS OF THE ISOENZYMES OF CREATINE KINASE IN TELEOSTEAN FISH. Comp. Biochem. Physiol., 42(2B): 221-226.

Studies on electrophoretically separable creatine kinase (CPK) isoenzymes from fish indicate significant differences as compared to higher vertebrates. The species of several fish orders are characterized by an extended heterogeneity of CPKs, which are observed in tissue-specific patterns of distribution. Isoenzymes different from the CPKs of skeletal muscle and brain have consistently been found in extracts from heart tissue, stomach, ovaries and testes. (Authors)

15360. Maetz, J., and D. H. Evans (Groupe de biologie marine, Departement de biologie du Commissariat a l'Energie Atomique, Station Zoologique, 06-Villefranche-sur-Mer, France). 1972. EFFECTS OF TEMPERATURE ON BRANCHIAL SODIUM EXCHANGE AND EXTRUSION MECHANISMS IN THE SEAWATER-ADAPTED FLOUNDER Platichthys flesus L. J. Exp. Biol., 56(3): 565-585.

The effects of short-term and long-term temperature changes on the branchial components of sodium balance have been studied in the seawater-adapted flounder Platichthys flesus. When fish adapted to 6°C are compared with fish adapted to 16°C a disturbance of sodium balance is observed; while the plasma level of sodium remains constant, an increased internal sodium space can be demonstrated isotopically. Increase of the muscle sodium content accounts for only a small part of the extra sodium content of the fish. The increased sodium load is the result of an impairment of the sodium-extrusion mechanism in the gills, and is demonstrated by the disappearance of the Na/K exchange activity of the gills. The passive sodium fluxes (by simple diffusion or exchange-diffusion) decrease only twofold. Abrupt temperature changes in the 6-21°C temperature range are followed by instantaneous and reversible changes of the total sodium efflux ($Q_{10} = 2$), of the sodium leak observed after transfer into fresh water ($Q_{10} = 1.7$) and of the Na/Na exchange ($Q_{10} = 2$). The Na/K exchange, which corresponds presumably to the active sodium extrusion mechanism, shows in contrast a much greater temperature dependence ($Q_{10} = 6$). The total sodium efflux follows the Arrhenius relation between 6 and 21°C. Abrupt transfer to higher temperatures (23-26°C) produces irreversible damage to the transport system. No compensatory acclimatization of the flux rates is observed during adaptation in the 6°C environment. The biological, physiological, ecological as well as biophysical implications of these findings are discussed. Particular emphasis is given to the problem of gill haemo-dynamics. (Authors summ.)

15361. Stevens, E. D. (Dept. of Zool., Univ. of Hawaii, Honolulu, Hawaii 96822). 1972. SOME ASPECTS OF GAS EXCHANGE IN TUNA. J. Exp. Biol., 56(3): 809-823.

Some aspects of gas exchange in restrained skipjack tuna were analysed. The average rate at which water flowed over the gills was 2.8 l/min. kg. The concentration of oxygen in water entering and leaving the gills was measured and used to calculate oxygen uptake (692 mg/h.kg) and utilization (0.71). The drop in hydrostatic pressure as water flowed over the gills was 1.9 cm water and agrees favourably with theoretical predictions. The partial pressure of oxygen was measured in blood afferent and efferent to the gills and used to calculate effectiveness of oxygen removal from the water (90%) and the transfer factor for oxygen (0.12 ml/min.kg.mmHg). The average utilization measured in free-swimming tuna was 0.56. The extraordinary ability of tuna to efficiently extract oxygen from the water at high gill water flow rates is discussed. (Auth. summ.)

15362. Maetz, J. (Groupe de Biologie Marine du Departement de Biologie du Commissariat a l'Energie Atomique, Station Zoologique, 06-Villefranche-sur-Mer, France). 1972. BRANCHIAL SODIUM EXCHANGE AND AMMONIA EXCRETION IN THE GOLDFISH Carassius auratus. EFFECTS OF AMMONIA-LOADING AND TEMPERATURE CHANGES. J. Exp. Biol., 56(3): 601-620.

Sodium influx and efflux and ammonia excretion by the gill have been studied as a function of external sodium chloride concentration in Carassius auratus before and after loading the fish with ammonia. No correlation between net sodium uptake and ammonia excretion is observed, either when the net uptake changes with an external sodium change or when net uptake increases with ammonia-loading. Branchial handling of chloride ions cannot explain this absence of correlation. Comparison of the concentrations of free base ammonia (NH_3) and of ammonium ions (NH_4^+) in both blood (dorsal aorta) and external medium at the end of the closed-circuit experiments on control or ammonia-loaded fish demonstrates that the gill is permeable to the ionized form of ammonia. An abrupt temperature decrease (16→6°C) affects the sodium influx ($Q_{10} \simeq 3$) much more than the sodium efflux ($Q_{10} = 1.7$). Sodium balance becomes negative unless the fish is ammonia-loaded. The observed

effects of temperature are reversible when the fish is returned to 16°C. Branchial ammonia excretion is highly temperature-sensitive (Q_{10} = 4) in control fish when metabolic production limits ammonia excretion. After ammonia-loading, when most of the ammonia cleared by the gill is exogenous, the effect of temperature on branchial permeability to ammonia (Q_{10} = 1.9) suggests a passive transfer of ammonium ions. The contributions of the kidney and the gill is sodium loss and ammonia excretion are compared in intact and ammonia-loaded fish. (Auth. summ.)

15363. Georgacakis, E., S. R. Chandran, and M. A. Q. Khan (Dept. of Biol. Sciences, Ill. Univ., Chicago, Illinois). 1971. TOXICITY-METABOLISM RELATIONSHIP OF THE PHOTOISOMERS OF CYCLODIENE INSECTICIDES IN FRESHWATER ANIMALS. Bull. of Environ. Contam. and Toxicol., 6(6): 535-538; Selected Water Resources Abstracts, 5(10): p. 49, 1972.

The toxicity-metabolism relationship of the photoisomers of the cyclodiene insecticides - aldrin, dieldrin, isodrin - in freshwater crustacea, fish and tadpoles was investigated in order to determine (1) if the increased toxicity of these photoisomers to freshwater animals was due to the faster onset of toxic symptoms and (2) whether this could then be related to their metabolism as in insects. Each of the experiments was done in replicate and repeated as least twice after the animals were acclimated to distilled water. The production of photodieldrin ketone from photodieldrin was studied by injecting the test animals with 120 nanograms of photodieldrin in methylcellusolve, extracting the products in hexane and analyzing the products by gas chromatography. The onset of toxic symptoms of photoaldrin and photodieldrin is 3-5 times faster than aldrin and dieldrin in crayfish, bluegills, and minnows and 1.3-2.2 times in other animals. Photoisodrin is 3-5 times slower than isodrin in its toxic action against other animals tested. The increased toxicity of photoaldrin and photodieldrin is apparently related to the rate of in vivo formation of more toxic ketones as observed with photodieldrin.

15364. Kidd, D. E., and G. V. Johnson (Water Resources Research Inst., N. M. State University, University Park, New Mexico). 1971. AN INVESTIGATION OF PRIMARY PRODUCTIVITY USING THE ^{14}C METHOD AND AN ANALYSIS OF NUTRIENTS IN ELEPHANT BUTTE RESERVOIR. Available from the Nat'l. Tech. Information Serv. as PB-207 351, $3.00 paper copy, $0.95 microfiche. Tech. Completion Report, 136 p., OWRR A-021-NMEX (1); Selected Water Resources Abstracts, 5(10): p. 54, 1972.

An investigation of the phytoplankton population structure, primarily productivity and the concentrations of the nutrients nitrate and phosphate was conducted in Elephant Butte Reservoir, New Mexico during 1970. Surface, one, and two meter samples were obtained at weekly or biweekly intervals at five stations extending from the outlet near the dam to the inlet of the Reservoir. This transect represented a gradient of increasing sediment load and decreasing transparency from the outlet to the inlet of the reservoir. Diversity and redundancy indexes were computed using counts obtained for 70 phytoplankton species identified. Significant correlations of diversity with temperature, productivity, and algal number were obtained while diversity was negatively correlated with depth and storage. It was apparent that the reservoir consisted of a lower and upper pool, the lower having a lower silt load and hence greater transparency, lower numbers of phytoplankton, lower primary productivity at the surface, lower concentrations of nitrate and phosphate, and generally more stable conditions. The nitrate concentration increased as storage decreased and the phosphate concentration increased with temperature. These correlations along with the high productivity during the warmer months when storage is decreasing indicate the need for maintenance of a minimum pool size to avoid possible algal blooms.

15365. Koshinsky, Gordon D. (Fish. Branch, Saskatchewan Dept. of Natural Resources, Province of Saskatchewan, Canada). 1965. LIMNOLOGY AND FISHERIES OF FIVE PRECAMBRIAN HEADWATER LAKES NEAR LAC LA RONGE, SASKATCHEWAN. Dept. of Natural Resources, Province of Saskatchewan, Fisheries Report No. 7, 52 p., illus.

15366. Dooley, James K. (Inst. of Marine Sciences, Univ. of N. C., Morehead City, North Carolina). 1972. FISHES ASSOCIATED WITH THE PELAGIC SARGASSUM COMPLEX, WITH A DISCUSSION OF THE SARGASSUM COMMUNITY. Contributions in Marine Science, Vol. 16, pp. 1-32.

From April 1966 through May 1967, some 3200 kgm (3.5 tons) of sargassum were collected in the Florida current. Analysis revealed approximately 8400 fishes belonging to 8 orders, 21 families, 35 genera and 54 species. The families Carangidae (14 species), Balistidae (14 species) and Antennariidae (1 species) numerically comprised 90% of all fishes collected. Sargassum was present in very low quantities in spring and winter, while tremendous quantities were available in summer and fall. Summer and fall were marked by fewer, larger fishes than winter and spring. As a consequence of surface current patterns, sargassum acts as a vehicle for dispersal of some of its inhabitants. The sargassum community appears to be important in the life histories of many species of pelagic, littoral and benthic fishes, providing them with a substratum, protection against predation and concentration of food in the open sea. (Auth.)

15367. Hunt, P. C., and J. W. Jones (Dept. of Zool., Univ. of Liverpool, Liverpool, England). 1972. THE EFFECT OF WATER LEVEL FLUCTUATIONS ON A LITTORAL FAUNA. J. Fish Biol., 4(3): 385-394.

The littoral fauna of Llyn Tegid, North Wales, in 1968/9 is compared with the results of similar faunal investigations made by Rothwell (nee Dunn) in 1951/2 (Dunn, 1953) and Hynes in 1957 and 1959 (Hynes, 1961). The results show the long term effects upon the littoral fauna of the change in mean water level and the increased water level fluctuations produced for a time by the controlled outflow scheme, which came into operation in 1955. In 1961 Hynes recorded big reductions in numbers and variety of invertebrates living in the littoral zone. The reduced water level fluctuations in recent years has resulted in a re-establishment of some of the fauna. (Authors)

15368. Kardos, Larry P., and Stephen W. Eaton. 1972. ZOOPLANKTON AND BENTHIC FAUNA OF CANANDAIGUA LAKE. Science Studies, St. Bonaventure Univ., St. Bonaventure, New York, Vol. 28, pp. 45-105.

Stratified plankton samples and temperatures were taken from April 1971 to January 1972. Changes in population structure and vertical distribution of zooplankton species are illustrated and numbers compared with earlier data. Temperatures are compared with earlier data, and bottom samples taken during June, August, and October are described. Larger zooplankters have declined since Birge and Juday. Smaller zooplankters have increased in numbers and species. The epilimnion is 1.5 to 2.0°C warmer than 1910-1918 and the lake was monomictic. Oligochaeta, Pontoporeia, and midges seem to be reduced 20-50% from 1910-1918, while Sphaerium has increased. (Authors)

15369. Halver, John E. (Bur. of Sport Fish. & Wildl., Western Fish Nutrition Lab., Cook, Washington). 1972. PRIORITIES IN FISH NUTRITION RESEARCH. "Progress in Fishery and Food Science" Proc. 50th Anniv., Symp. College of Fisheries, Univ. of Washington Press., pp. 141-143.

We should not delude ourselves on what has been learned in the past decade or two about basic fish nutrition. Only a few tentative requirements for certain special species have been accumulated, and most of these have been recorded only under special test conditions and for one size of experimental animal. Very little work has been done on sparing the effect of one nutrient upon another; on changes in nutritional requirements with age, size, or temperature of the environment; and even less work has been done on the role of nutrition in developing resistance to disease, response to stress, and sensitivity to adventitious toxins encountered in the food or in the environment. There are larger unexplored problems in fish nutrition research, however, which should be considered now. Obviously, more and more effort will be expended in the area of farming the edges of the sea by the use of principles of sound animal husbandry, to turn present beginnings in estuarine fish culture into marine fish husbandry. Nutritional requirements of the species to be reared must be defined before an adequate dietary can be formulated. Before

fundamental requirements can be measured, a complete test diet must be available that will maintain the fish without the appearance of any nutritional deficiency syndrome for an extended period. Most of the marine species to be reared feed first as larval forms. This circumstance poses another challenging problem, not only for basic nutrition research, but for fishery technology as well, that is, formulation of a standard test diet that will enable the experimenter to have control over the particular nutrients to be tested, and development of this test diet in micropellet form such that it will be insoluble in water, soluble in acid, and with zero or slightly negative buoyancy to allow maximum dispersal in water in a form that the larvae may capture and ingest to start the growth process.

15370. Wieclawski, Franciszek. 1972. INVESTIGATIONS ON THE CHANGES IN THE CONTENT OF HEAVY METALS IN LAKE WATERS OF THE MASURIAN LAKE DISTRICT. (Badania zmian zawartości metali ciężkich w wodach jeziorowych Pojezierza Mazurskiego). Acta Hydrobiol., 14(2): 149-163.

Waters from two levels of lakes of the Masurian Lake District were investigated from 13th November 1967 to 13th May 1968 for the content of traces of heavy metals in ionic form. The chosen lakes (Trzcinno, Kortowskie, Mutek, Starodworskie, and Dlugie) represent types from β-mesotrophy to advanced eutrophy remaining under the influence of pollution. The range of variations in the content of traces of ions of heavy metals in μg/l determined according to the polarographic method after their preliminary concentration on a dithizone column is the following: Pb 0.2-2.2, Cd 0.0-0.3, Zn 0.2-9.7, Mn 0.0-9.8, Cu 0.1-4.5, Co < 0.1. These microelements, ordered in a sequence of decreasing concentrations, form the following series: Mn, Zn, Cu, Pb, Cd, and Co. Manganese and zinc showed the greatest seasonal variability and lead the least. The occurrence of a larger amount of microcomponents of waters, particularly distinct for zinc, was observed three times in the course of these investigations, namely during the freezing over of lakes, during the period of culminant inflows of waters from the catchment basins to the lakes, and in the early season of spring "blooms" of lake waters. No passing of ions of heavy metals from sediments to waters was observed. (Auth.)

15371. Nelson, Joseph S., and F. Mervyn Atton (Dept. of Zool., The Univ. of Alberta, Edmonton, Alberta, Canada). 1972. GEOGRAPHIC AND MORPHOLOGICAL VARIATION IN THE PRESENCE AND ABSENCE OF THE PELVIC SKELETON IN THE BROOK STICKLEBACK, Culaea inconstans (Kirtland), IN ALBERTA AND SASKATCHEWAN. Canad. J. Zool., Vol. 49, pp. 343-352, illus.

Brook sticklebacks, Culaea inconstans (Kirtland), are known from 20 locations in Alberta and Saskatchewan in which a high proportion of the individuals lack all or part of the pelvic skeleton. These locations are interspersed and surrounded by other locations containing individuals with a normal pelvic skeleton. Individuals which lack the skeleton are of both sexes and are fertile in at least one of the lakes. Considerable variation exists between locations in the proportion of individuals with and without the pelvic skeleton. Morphological intermediates are known from most of the 20 locations and virtually all degrees of pelvic skeleton formation exist between its absence and its full development. Little or no gradation exists, however, in pelvic spine length between their absence and presence. Although the pelvic spines are the first part of the pelvic skeleton to appear during ontogeny, they are present only in intermediates with a virtually complete skeleton base. In addition, many intermediates are highly asymmetrical in their pelvic skeleton while development during the ontogeny of normal individuals is symmetrical. There is a greater tendency for individuals in which the pelvic skeleton is deficient to occur in lakes which lack an outlet rather than to occur in lakes with a permanent outlet. An unusually high proportion of the lakes with these aberrant individuals have been subject to fishery management activities (fish introduction and poisoning), but these disturbances are not causing the loss of the pelvic skeleton. (Authors)

15372. International Pacific Salmon Fisheries Commission. 1972. ANNUAL REPORT 1971. Internat'l Pacific Salmon Fish. Comm., New Westminster, Canada, 60 p.

15373. Brezina, Edward R., Robert S. Campbell, and James R. Whitley (Div. of Water Qual., Pa. Dept. of Health, Harrisburg, Pennsylvania). 1970. EFFECTS OF ACID MINE DRAINAGE ON WATER QUALITY OF A RESERVOIR. J. Wat. Poll. Contr. Fed., 42(8): 1429-1436, Part I.

This 15-month study of water quality in mine drainage in Montrose Reservoir and tributary Deepwater Creek demonstrated that acid water pollution altered the water quality of Montrose Reservoir. The authors found differences in specific conductance, sulfate ion concentration, and bicarbonate alkalinity between runoff water and reservoir water. Increase in specific conductance related to increase in sulfate compounds would point to acid mine pollution as the causal factor. Decrease in bicarbonate alkalinity indicated a decrease in buffering capacity caused by acid inflow. Comparison of water quality conditions within Deepwater Creek above and below the site of acid mine drainage discharges indicated that Deepwater Creek received acid water inflow from adjacent strip mines. The relationship of time of acid inflow to rainfall was established by hourly monitoring of water quality in Deepwater Creek before, during, and following heavy rainfall. The major change in creek water quality occurred within 1.5 hr of onset of rain. The pH measurements did not show the water quality alteration so clearly indicated by specific conductance, sulfate ion concentration, and bicarbonate alkalinity. Buffering capacity of the inflowing water was never reduced sufficiently to result in a large pH change. The best indication of any accumulation of strip-mine effluent material probably is the sulfate ion because it is quite soluble, not known to be utilized by higher organisms, and probably depleted only by the activity of microorganisms and chemical tie-up in the bottom muds. (Authors conclusions)

15374. Schneider, James C. 1971. ANGLING ON MILL LAKE AFTER A 5-YEAR PERIOD OF NO FISHING. Mich. Dept. of Natural Resources Research and Development Report No. 253, 14 p.

Mill Lake, a 136-acre warmwater lake in Washtenaw County, Michigan, was closed to fishing from October 1, 1964 to August 1, 1969, for a study of fish population dynamics. This is a report on the creel census conducted the first 3 days the lake was reopened to angling, August 1-3, 1969. The average catch per hour was 1.1. For other southern Michigan lakes the average is 1.0. Although this difference appears to be slight, the latter average includes the months of June, July and September which are better times to fish than is August. Exploitation of game fish in the lake was disproportionately high. The presumed annual quota (35%) of largemouth bass was harvested from Mill Lake with one-third the expected effort. Exploitation of pumpkinseed sunfish and perch was, likewise, very high for the amount of effort expended. About one-half of the usual annual quota of bluegills and black crappies was taken during the 3 days. However, there appears to be little danger of a serious depletion of the fish population. As fishing quality drops, due to a decline in stock and to a decrease in catchability, fishing pressure also declines.

15375. Marcy, Barton C., Jr. (Essex Marine Lab., Inc., Novelty Lane, Essex, Connecticut 06426). 1972. SPAWNING OF THE AMERICAN SHAD, Alosa sapidissima IN THE LOWER CONNECTICUT RIVER. Chesapeake Science, 13(2): 116-119.

Eggs were collected using plankton nets in the lower 54 miles of the Connecticut River during 1967 and 1968 to locate spawning areas of American shad and to determine environmental factors influencing spawning success. Spawning occurred between 13 May and 27 June, the peak being June in 1967 and May in 1968. Shad spawned throughout the study area, but primarily above mile 28. Based on egg age and river flows, most eggs could have traveled 1 to 4 miles from the spawning sites. Shad arrived earlier in 1968 and spawned earlier and further downstream than in 1967, possibly due to warmer temperatures in May 1968. Lower water temperatures in June 1968 may have contributed to the higher egg mortality observed in that year (18% in 1967 and 30% in 1968). Most eggs in 1968 (65%) were collected in temperatures lower than 16.0 C, as opposed to only 3% in 1967. Other investigators have shown that shad eggs developing at these low temperatures have a prolonged development and reduced survival; the paucity of juveniles collected in 1968 gave supporting evidence for a weakened year class. (Auth.)

15376. Reeves, J. E., and G. S. DiDonato. 1972. EFFECTS OF TRAWLING IN DISCOVERY BAY, WASHINGTON. Wash. Dept. of Fisheries Technical Report No. 8, 45 p.

Trawl fishery regulation changes implemented in Discovery Bay, Washington in November 1967 resulted in an intensification of an existing recreational-commercial fishery conflict. The present study was undertaken in an attempt to alleviate this conflict. The average trawl catch of bottomfish in Discovery Bay has been 165,000 lbs. over the past eight seasons. English sole (Parophrys vetulus), Pacific cod (Gadus macrocephalus) and starry flounder (Platichthys stellatus) are the major species comprising the catch. Trawling is done primarily in 16-25 fathoms of water. The fishery historically began in the fall and ceased in late spring. In January 1968, a 2-1/2 month season from December 1 - February 14 was implemented and additional area in the southern half of the bay was opened to trawling. These changes have resulted in increases in total catch, total effort, and CPUE for most of the commercially caught species. Tagging studies, begun in November and December 1968, demonstrate that the Discovery Bay English sole can be treated as a unit stock. Data from the tagging experiment and logbook records of catch and effort were used to assess the effects of fishing on English sole, the main groundfish in the Discovery Bay trawl fishery. From the tagging experiment, designed to correct for Type 1 errors, the proportion of the total population caught (rate of exploitation) during the 1968-1969 season was determined to be between 10 and 25%. Fitting the logistic production model to catch and effort data for all seasons since 1957, indicates that the level of trawling effort for English sole has never surpassed the level required to overfish the stock. Sport fish surveys conducted between November 1968 to April 1969 indicated almost all of the fishermen during this time period were after salmon but depletion of bottomfish species was indicated as a major concern. On-the-water surveys directed toward the capture of bottomfish, however, indicates substantial recreational opportunity for bottomfish exists in areas throughout the bay. Other concerns such as the potential effect of trawl gear on eel grass beds and herring (Clupea pallasi) were investigated. These observations revealed that virtually all the macro-vegetation was found inshore of the depths fished by the trawl fleet. Fouling of the beaches with discarded fish did not materialize - a concern also expressed by residents of the area. The results of the analyses indicate that the English sole resource is not being over-exploited by the commercial fishery and that good recreational fishing opportunities for bottomfish species are available. It is also apparent that the commercially important English sole are not harvested by the sport fishery. Sport fish surveys indicate that the shallow-water species, rock sole (Lepidopsetta bilineata), is the principal flatfish species available to sport gear. Accordingly it appears that for the present time, the two fisheries are compatible and allow for a more optimum utilization of the bottomfish resources in Discovery Bay than would be the case if the commercial trawl fishery was closed. (Authors)

15377. Reid, Gerald M. (NMFS Auke Bay Fish. Lab., Auke Bay, Alaska 99821). 1972. ALASKA'S FISHERY RESOURCES --- THE PACIFIC HERRING. U. S. Dept. of Commerce, NOAA, NMFS, Fishery Facts - 2, 20 p., illus.

The Pacific herring, Clupea harengus pallasi, is a valuable natural resource in the coastal waters of Alaska, not only because of its direct commercial significance but also because of its importance as a component in the complex food cycle of other commercially valuable fishes. Pacific herring are indigenous to the North Pacific rim and are closely related to the herring of the Atlantic Ocean. Pacific herring generally spawn on intertidal vegetation in the spring. Although spawning is often successful in terms of density, subsequent mortality of eggs and larvae may exceed 99%. Herring abundance fluctuates greatly. Biologists have attempted to understand and predict fluctuations by studying changes in the numerical strength of different year classes of herring taken by the commercial fisheries. Commercial utilization of Alaska herring by American fishermen is at a low level because of various socioeconomic problems, although thousands of tons were taken in the past for food and industrial products. Foreign vessels are currently taking large quantities of herring in areas offshore from Alaska. A viable herring industry

might develop if an economical method of producing fish protein concentrate from fatty fish is developed. Alaska herring reduced to the concentrate could provide an essential item in the diet of peoples of protein-deficient nations. (Auth.)

15378. Sinclair, Norman R. (Marine Inst., Univ. of Ga., Sapelo Island, Georgia). 1972. STUDIES ON THE HETEROPHYID TREMATODE Apophallus brevis, THE "SAND-GRAIN GRUB" OF YELLOW PERCH (Perca flavescens). II. THE METACERCARIA: POSITION, STRUCTURE, AND COMPOSITION OF THE CYST; HOSTS; GEOGRAPHICAL DISTRIBUTION AND VARIATION. Can. J. Zool., 50(5): 577-584.

The metacercarial cyst of Apophallus brevis, the "sand-grain grub," is composed of fish bone within peripheral blood vessels of yellow perch (Perca flavescens) forming a tire-like structure; two escape canals are maintained opposite each other. In thin section, lines indicating interruption of growth apparently delimit annual incrementation as in scales and other bony structures of fish. Cysts are oriented with their long axes paralleling the long axis of a host's body with escape canals contiguous to walls of enclosing blood vessels. Cysts of A. brevis in situ at times appear partially or entirely pigmented but are actually transparent; pigmentation, when present, is a phenomenon of a cyst's position within certain types of blood vessels and is not an integral part of a cyst's construction. The organism as a metacercaria is almost exclusively a parasite of yellow perch (known deviations are noted) and is apparently confined to North America, having a known broad range from Saskatchewan to Cape Cod, Massachusetts. Distribution is extremely diffuse and appears dependent on patchy distribution of the organism's molluscan host, Amnicola limosa. Geographical variation in cyst site selection and clustering indicates some sort of intraspecies inhibition on the part of metacercariae of A. brevis. (Auth.)

15379. Eales, J. G. (Dept. of Zool., Univ. of Manitoba, Winnipeg, Manitoba, Canada). 1972. RADIOTHYROXINE METABOLISM IN SEVERAL FRESHWATER TELEOST FISHES. Can. J. Zool., 50(5): 623-631.

The metabolism of intraperitoneally injected radiothyroxine labeled with ^{125}I in 3' and 5' positions ($*T_4$) was followed in several starved freshwater teleosts acclimated at 12-13°C. Biological half-lives for initial loss of plasma PB^{125}I ($*T_4$) were 7.9 h (goldfish), 8.7 h (rainbow trout), 12.2-28.5 h (channel catfish), 19.2 h (sucker), 24.0-37.6 h (burbot), and 56.6-138.0 h (brown bullhead). Frequently, a single exponential decrease in plasma PB^{125}I did not occur, and the usually large $*T_4$ distribution spaces suggested that injected $*T_4$ might not rapidly enter the circulation from the injection site. Plasma radioactive derivatives included 3, 5, 3' triiodo-L-thyronine. Biliary $*T_4$ excretion varied considerably between species and could relate to feeding habits. (Auth.)

15380. Joseph, Edwin B. (Va. Inst. of Marine Sci., Gloucester Point, Virginia). 1972. THE STATUS OF THE SCIAENID STOCKS OF THE MIDDLE ATLANTIC COAST. Chesapeake Science, 13(2): 87-100.

Population trends of the Atlantic croaker, Micropogon undulatus, the weakfish, Cynoscion regalis and the spot, Leiostomus xanthurus are described from historical catch records. Croaker populations north of Cape Hatteras increased from low levels in the early 1940's, but declined precipitously thereafter. It is suggested that climatic factors were more likely responsible than was fishing effort. Weakfish stocks were high at the beginning of the century and remained so through the 1930's. The dramatic decline since that time seems to be related to over-exploitation in part, but may also have been influenced by the widespread use of DDT. Spot stocks appear to have declined in the northern part of the range, but Chesapeake Bay populations show only the random year-to-year fluctuations typical of a short life cycle species. (Auth.)

15381. Sweet, B. H., and R. D. Ellender (Public Health Sci. Div., Gulf South Research Inst., P.O. Box 26500, New Orleans, Louisiana 70126). 1972. ELECTRO-OSMOSIS: A NEW TECHNIQUE FOR CONCENTRATING VIRUSES FROM WATER. Water Research, 6(7): 775-779.

15382. Hopkins, C. L. (Fish. Res. Div., Marine Dept., Wellington, New Zealand). 1971. PRODUCTION OF FISH IN TWO SMALL STREAMS IN THE NORTH ISLAND OF NEW ZEALAND. N. Z. J. of Marine and Freshwater Research, 5(2): 280-290.

Data are presented on biomass, mortality, growth, and production of fish populations inhabiting two small streams in the Wairarapa district of the North Island of New Zealand. The main water of both streams contained a mixed population of bullies (Philypnodon breviceps Stokell), brown trout (Salmo trutta Linn.), and eels (Anguilla dieffenbachii Gray, and A. australis schmidtii Phillipps). The headwater tributaries of one of the streams contained a large population of Galaxias divergens Stokell and a few eels, but other fish species were absent. All species of fish appeared to be using the same food supply of small benthic invertebrates, mainly ephemeropteran and dipteran larvae. Biomass of benthos per unit area was appreciably higher in the headwater tributary examined than in the main waters downstream. Mean annual stock of benthos in the tributary (Hinau north branch) was 19.75 g/m^2, in the Hinau main water 10.71 g/m^2 and in the Hinaki main water 13.47 g/m^2. Nevertheless, production per unit area from the nearly monospecific fish population in the Hinau north branch (14.28 g/m^2) was less than that of the mixed populations in the main waters (24.17 g/m^2) in the Hinau, 73.54 g/m^2 in the Hinaki). Possibly fish production in the headwaters might be greater if the species composition of fish was more diverse. (Auth.)

15383. Rucker, Robert R. (Western Fish Disease Lab., U. S. Bur. of Sport Fish. and Wildl., Sand Point Naval Support Activity, Seattle, Washington). 1972. FISH DISEASE THERAPY: PAST, PRESENT, AND FUTURE. "Progress in Fishery and Food Science" Proc. 50th Anniv., Symp. Coll. of Fisheries, Univ. of Washington Press, pp. 135-140.

In the past the therapy of fish diseases was little understood. Today we have controls for many diseases, but they are restricted because of FDA regulations. In the future we should try not only to obtain FDA clearance for these agents, but to control diseases in other ways. Some diseases can be controlled by modification of the environment, by temperature control, change of nutrition, genetics, and new vaccines. We hope to improve all of these measures in the future. (Auth. conclusion).

15384. Millard, Timothy J., and Hugh R. MacCrimmon (Dept. of Zool., Univ. of Guelph, Guelph, Canada). 1972. EVALUATION OF THE CONTRIBUTION OF SUPPLEMENTAL PLANTINGS OF BROWN TROUT Salmo trutta (L.) TO A SELF-SUSTAINING FISHERY IN THE SYDENHAM RIVER, ONTARIO, CANADA. J. Fish Biol., 4(3): 369-384.

An autumn planting of 4000 tagged yearling brown trout Salmo trutta (L.) in 1969 resulted in an over-winter survival of 26%, an angler recovery the following year of 8.1% and made up 22% of the March, 1970 standing population of the species. August standing populations of brown trout increased from 142 trout/ha (17.6 kg/ha) in 1969 to 360 trout/ha (39.3 kg/ha in 1970 while angler harvest of the species increased from 61 trout/ha (12.7 kg/ha) at a rate of 0.26 fish/h to 89 trout/ha (18.5 kg/ha) at a rate of 0.34/h. Using angler recovery and standing population as criteria the planting contributed substantially to the fishery. Actual contribution of stocked trout however, is questioned after detailed analysis of resident population structure and the potential of natural recruitment. It is suggested that the true benefit of stocked trout may be measured by the presence of those stocked fish in excess of the number of resident trout of that size predictable from a normal length distribution curve in waters with self-sustaining populations. Complexities in evaluating the merits of supplemental plantings of hatchery-reared brown trout to existing stream fisheries are examined. (Authors)

15385. Jamsen, Gale C. 1972. MICHIGAN'S 1971 SPORT FISHERY. Michigan Dept. of Natural Resources Research and Development Report No. 268, 7 p.

15386. Wajdowicz, Zbigniew. 1972. REMARKS ON THE STOCKING OF THE DAM RESERVOIR AT PRZECZYCE WITH LAKE TROUT. (Uwagi o wsiedleniu troci jeziorowej (Salmo trutta m. lacustris L.) do zbiornika zaporowego w Przeczycach). Acta Hydrobiol., 14(2): 205-212.

As the result of stocking the dam reservoir at Przeczyce numerous young lake trout were found in the river above the dam and individual adult specimens were found in the reservoir. During autumn a few spawning migrations of mature lake trout from the reservoir to the river were observed. Individual spawned females were found, but no spawning traps. Smolts of lake trout were bred from artificially inseminated spawn. The emptying of the reservoir interrupted the process of acclimatization. Some factors impeding full acclimatization, which is determined by natural spawning, are described. (Auth.)

15387. Flain, M. (Fisheries Lab., Christchurch, New Zealand). 1971. SOCKEYE SALMON Oncorhynchus nerka (Walbaum). New Zealand Marine Dept. Fish. Div. Reprint No. 45, 2 p.

The establishment of the sockeye in New Zealand resulted from only one batch of eggs received from Canada in 1901-2. Five thousand fry were liberated in tributaries of the Waitaki River. The following year 10,000 parr and 1,500 two year class fish were liberated into the Hakataramea River. A further 5,981 three year class fish were liberated into the same river, 1,283 later still and finally 34 four year class fish were released. On the 5th of April, 1929, a spawning run occurred in the head waters of Lake Ohau. After the completion of the Aviemore Spawning Race on the Waitaki River, considerable interest was generated by the occurrence of a sizeable run of sockeye into it. During March 1969 approximately two hundred fish used the race. These fish have no access from the sea as they are stopped by the Waitaki Dam, therefore they have spent all their life in freshwater.

15388. Flain, M. (Fisheries Lab., Christchurch, New Zealand). 1971. QUINNAT SALMON Oncorhynchus tshawytscha (Walbaum) RUNS IN THE HAKATARAMEA RIVER 1969-70-71. New Zealand Marine Dept. Fish. Div. Reprint No. 42, 1 p.

The age structure of the 1969, 1970 and 1971 runs in the Hakataramea River fits the normal pattern for Quinnat salmon in New Zealand. A. - III year class dominant. B. - IV year class second most important (sometimes dominant year class). C. - II year class third in importance (sometimes second most important); II year males considerably outnumber II year females, the occurrence of the latter is a distinctive feature of New Zealand runs, and is not recorded for North American runs. D. - V year class rare. E. - Older than V not observed (in any New Zealand runs). The age composition and growth rates are directly comparable with those of other sea runs of salmon in New Zealand rivers, but like the runs in other rivers they are younger at maturity than those runs that occur in North America. (Auth. discussion)

15389. Sonstegard, R. A., and L. A. McDermott (Dept. of Microbiology, Coll. of Biol. Sci., Univ. of Guelph, Guelph, Ontario, Canada). 1972. EPIDEMIOLOGICAL MODEL FOR PASSIVE TRANSFER OF IPNV BY HOMEOTHERMS. Nature, 237(5350): 104-105.

The isolation of IPN virus from the faeces of inoculated chicken, great horned owl and mink suggests that a wide variety of warm blooded animals could be "mechanical vectors" of the virus.

15390. Hagenmaier, H. E., and R. Wilhelm (Zool. Inst. der Univ. Münster, Münster, Germany). 1972. ON THE HATCHING PROCESS IN FISH: I. THE BUILDING OF THE EGGSHELL AND ITS CHANGES DURING GERM DEVELOPMENT IN THE TROUT (Salmo trutta fario L.). [Zum Schlüpfprozess bei Fischen: I. Der Aufbau der Eihülle und ihre Veränderungen während der Keimesentwicklung bei der Forelle (Salmo trutta fario L.).] Experientia, 28(5): 605-607. In German with English summary.

The investigation of the eggshell of Salmo trutta fario L. reveals several layers, which are chemically and physically different. During development of

the egg, the chorion does not show notable changes in structure. Immediately at hatching the dissolution of the egg takes place as a result of the glands being on the head of the embryo. (Authors summ.)

15391. Campbell, Robert S., and James R. Whitley (Zool. Dept., Univ. of Missouri, Columbia, Missouri). 1970. EFFECTS OF AGRICULTURAL POLLUTANTS ON RECREATIONAL USES OF SURFACE WATERS. Reprint from Agricultural Practices and Water Quality, Chapter 24: 331-343. The Iowa State Univ. Press, Ames, Iowa., 415 p.

Unquestionably many agricultural pollutants affect recreation through alteration of water quality and degradation of fish and aquatic life. The more serious polluting agents we judge to be eroded soil, nutrients, and pesticides. We sense there is an awareness and appreciation of the problem among those concerned with agriculture. While the problems relating to agricultural pollution are complex, and the solutions will not easily be attained, it seems reasonable that in many instances alternative procedures can be developed. Pollution control measures are available (e.g., pesticides) which will allow continuation of agricultural production and enhance and protect water quality and recreation. While these procedures may be costly to apply, the expenditure should be judged in light of its contribution toward the preservation of man's environment. Especially in the instance of pesticide use, protection of water quality may be requisite to protection of the health of man from unknown long-term effects of pesticides. Reduction and control of agricultural pollutants are essential to develop and maintain a high-quality environment. Quality of life and quality of environment are synonymous. (Authors conclusions)

15392. Koshinsky, Gordon D. (Saskatchewan Fisheries Lab., Saskatoon, Saskatchewan, Canada). 1970. THE MORPHOMETRY OF SHIELD LAKES IN SASKATCHEWAN. Limnol. and Oceanogr., 15(5): 695-701.

Morphometric data are presented for 68 lakes on the Precambrian Shield in Saskatchewan. The lakes have a wide range of surface dimensions but share a common history and a distinctive geologic environment. Basin form, insulosity, and lake configuration are examined in relation to lake areas and are found to be dependent. The nature of this dependency is linked to characteristics of lake origin and geology peculiar to the shield region. (Auth.)

15393. Khan, R. A. (Dept. of Biol., Memorial Univ. of Newfoundland, St. John's, Newfoundland, Canada). 1972. ON A TRYPANOSOME FROM THE ATLANTIC COD, Gadus morhua L. Can. J. Zool., 50(7): 1051-1054.

Trypanosomes were found in 145 (24%) of 610 Atlantic cod, Gadus morhua L. following examination of centrifuged blood samples. The smallest infected fish measured 26 cm. Generally, parasitemias were higher in cod 26-35 cm long than in larger fish, but were more prevalent among fish 56-70 cm. The parasite could not be transmitted experimentally to Pseudopleuronectes americanus, Myoxocephalus octodecemspinosus, M. scorpius, Tautogolabrus adspersus, or Limanda ferruginea, but uninfected cod were susceptible. The trypanosome appears distinct from Trypanosoma coelorhynchi Laird, 1951 from gadiform fishes in New Zealand waters. It is tentatively identified as T. murmanensis Nikitin, 1927 reported from the same host, G. morhua, captured at Murmansk, U.S.S.R. (Auth.)

15394. Leduc, Gerard (Dept. of Biol. Sci., Sir George Williams Univ., Montreal, Quebec, Canada). 1972. CHANGES OF BLOOD CHLORIDE AND OSMOLARITY IN TWO STOCKS OF SALMON PARR (Salmo salar) DURING SHORT-TERM EXPOSURE TO SEAWATER. Can. J. Zool., 50(7): 1019-1021.

Two stocks of hatchery-reared Salmo salar parr were tested for change of blood chloride and plasma osmotic concentration following their transfer from freshwater to diluted seawater for periods up to 256 h. One group of fish originated from an anadromous population (Atlantic salmon) while the others were from a freshwater stock (ouananiche). The results suggest that, at least at the parr stage, the young salmon of both groups have very similar osmoregulation. (Auth.)

15395. Fahmy, Fahmy K. (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1972. HETEROGENEOUS ACCLIMATION OF FISH TO TEMPERATURE. Can. J. Zool., 50(7): 1035-1037.

Brook trout were acclimated heterogeneously for 3 weeks by exposing the head and tail simultaneously to two different temperatures. Time to death at a lethal temperature was taken as a measure of resistance acclimation. The relation between the resistance acclimation and mean temperature of the whole fish during acclimation indicated that the response of the whole organism depends on the mean thermal history of the total tissue regardless of the anatomical site. The mechanism through which a fish can acclimate to a higher or lower level of temperature is still unknown and whether the central nervous system has a direct or indirect role on such acclimation is not yet clear. (Auth.)

15396. Whiteside, B. G., and Randy M. McNatt (Aquatic Sta., Biol. Dept., Southwest Texas State Univ., San Marcos, Texas 78666). 1972. FISH SPECIES DIVERSITY IN RELATION TO STREAM ORDER AND PHYSICOCHEMICAL CONDITIONS IN THE PLUM CREEK DRAINAGE BASIN. Amer. Midl. Nat., 88(1): 90-101.

Water and fish samples were collected at 202 sampling stations throughout the Plum Creek drainage basin in south central Texas between January and April 1968. Fish species diversity ($\overline{D}$) was analyzed to determine its relationship to stream order and physicochemical conditions. Fluctuations in physicochemical conditions decreased as stream order increased. Twenty-seven species of fishes were collected. Minimum, maximum and mean numbers of species per stream increased as stream order increased through the first four stream orders and decreased in the fifth-order stream. Mean $\overline{D}$ values decreased from first-order to second-order streams, then increased through fourth-order streams; and decreased again in the fifth-order stream. Cumulative $\overline{D}$ values increased through third-order streams and decreased in fourth- and fifth-order streams. In general, $\overline{D}$ values for adventitious streams correlated with trends in $\overline{D}$ values for the higher order stream into which the adventitious stream flowed. The decrease in number of species and in species diversity in the fifth-order stream may have been due to migration of fishes into lower order streams for spawning purposes and/or to escape abnormally high water in the fifth-order stream. Also, increased depth and obstacles, such as logs and barbed wire, may have reduced seining efficiency in the fifth-order stream. (Authors)

15397. Echelle, Anthony A., Alice F. Echelle, and Loren G. Hill. (Univ. of Okla. Biol. Sta., Willis, Oklahoma 73462). 1972. INTERSPECIFIC INTERACTIONS AND LIMITING FACTORS OF ABUNDANCE AND DISTRIBUTION IN THE RED RIVER PUPFISH, Cyprinodon rubrofluviatilis. Amer. Midl. Nat., 88(1): 109-130.

The Red River pupfish, Cyprinodon rubrofluviatilis, was positively associated in occurrence with Fundulus zebrinus, Hybognathus placitus and Notropis bairdi and negatively associated with a large, predominantly fresh-water (salinity $<$ 10 ppt) complex composed of Notropis lutrensis, Gambusia affinis, Lepomis spp. and Pimephales spp. Although occurring in dilute waters, the pupfish was virtually restricted to saline conditions (salinity $>$ 10 ppt) where few other species occurred. An apparent lack of intrinsic limiting factors was demonstrated. The pupfish seems adapted to a broad ecological niche, creating competition with an array of fresh-water forms that are better adapted to exist in richer faunas. A W to E filter-bridge based on decreasing numbers of saline streams seems to be the major factor limiting eastward distribution of the pupfish. Competition and direct behavioral interaction with the pupfish seemed to be major factors depressing F. zebrinus populations in saline waters. A variety of "broad adaptations" of the pupfish may halp to confer a numbers advantage over F. zebrinus, magnifying the effects of behavioral interaction. These effects may also help make the pupfish successful at moderate salinities (10-20 ppt) where there are at least 12 potentially competing species. (Authors)

15398. Leiby, P. D., D. C. Kritsky, and C. A. Peterson (Dept. of Biol., Minot St. College, Minot, North Dakota). 1972. STUDIES ON HELMINTHS OF NORTH DAKOTA. III. PARASITES OF THE BIGMOUTH BUFFALO, Ictiobus cyprinellus (Val.), WITH THE DESCRIPTION OF THREE NEW SPECIES AND THE PROPOSAL OF Icelanonchohaptor gen. n. (Monogenea). J. Parasit., 58(3): 447-454.

Three new monogenetic trematodes, Icelanonchohaptor icelanonchohaptor, Pellucidhaptor planacrus, and Gyrodactylus dakotensis, are described from Ictiobus cyprinellus (Val.) from the Missouri River in North Dakota and South Dakota. Icelanonchohaptor gen. n. is proposed. Anonchohaptor Mueller, 1938 is removed from the Calceostomatidae along with the new genus included in the Dactylogyridae. The digenetic trematode, Lissorchis gullaris Self and Campbell, 1956, and 2 nematodes, Camalanus ancylodirus Ward and Magath, 1916, and Philometra sp., are reported for the first time from the Missouri River. (Authors)

15399. Burris, Kenneth Wayne, and Grover C. Miller (Zool. Dept., North Carolina St. Univ., Raleigh, North Carolina). 1972. Ergasilus rhinos sp. n. (COPEPODA: CYCLOPOIDA) FROM THE NASAL FOSSAE OF THREE CENTRARCHID FISHES OF NORTH CAROLINA. J. Parasit., 58(3): 600-604.

Ergasilus rhinos sp. n. is described from 3 centrarchid fishes: Centrarchus macropterus, the flier; Lepomis gibbosus, pumpkinseed; Lepomis auritus, redbreast; collected from the Black River, a tributary of the Cape Fear River, North Carolina. All specimens were recovered from the nasal fossae. E. rhinos differs from all other members of the genus Ergasilus in the armature of the antenna. It differs from all other North American species except Ergasilus megaceros in its location on the host. (Authors)

15400. Mayer, F. L., Jr., J. C. Street, and J. M. Neuhold (Animal Sci. Dept. and Ecol. Center, Utah State Univ., Logan, Utah). 1972. DDT INTOXICATION IN RAINBOW TROUT AS AFFECTED BY DIELDRIN. Toxicol. Appl. Pharmacol., 22(3): 347-354.

Rainbow trout were dosed po with 5 mg DDT alone and in combination with 0.04 mg or 0.20 mg dieldrin on alternate days, 4 treatments in all. Fish were also pretreated on 4 alternate days with 0.20 mg dieldrin per dose followed by 4 alternate day treatments of 5 mg DDT per dose. The presence of dieldrin resulted in reduced mortality from DDT intoxication. The time until death after demonstrating signs of intoxication was also much longer in fish receiving dieldrin in addition to DDT than in those receiving DDT only. DDT increased with time in adipose tissue, but the lethal brain levels of DDT were nearly constant. It was observed that rainbow trout die at a much lower brain level of DDT than reported for rats or birds. (Authors)

15401. Wells, Marion R., and James D. Yarbrough (Dept. of Zool., Miss. State Univ., State College, Mississippi). 1972. RETENTION OF ^{14}C-DDT IN CELLULAR FRACTIONS OF VERTEBRATE INSECTICIDE-RESISTANT AND SUSCEPTIBLE FISH. Toxicol. Appl. Pharmacol., 22(3): 409-414.

DDT resistant and susceptible populations of mosquitofish (Gambusia affinis) were assayed for DDT retention in particulate fractions of livers and brains following in vivo and in vitro treatment in ^{14}C-DDT. Livers and brains were homogenized, and particulate fractions were prepared by differential centrifugation and counted for radioactivity. The in vivo studies indicate a significant difference in retention between brains from susceptible and resistant fish and point to a membrane barrier to DDT in tissues from resistant fish. There is also a more effective blood-brain barrier in resistant fish than in susceptible fish. There was a difference in total distribution of DDT based on percent retention in brain tissue of resistant and susceptible fish. It appears that the cell membranes of resistant fish retain DDT, thus reducing the amount entering the cell. The opposite effect is seen in the mitochondrial membrane as DDT is apparently prevented from entering rather than being membrane bound. In the in vivo liver treatments the heavy microsome fraction was the only significantly different cell component in which the heavy microsomes from resistant fish retained more ^{14}C-DDT than those from susceptible fish. For the in vitro treatments all liver fractions from susceptible fish showed a significantly greater retention than did those from resistant fish. (Authors)

15402. Ritchie, Jerry C. (U. S. Dept. of Agric. Sedimentation Lab., Oxford, Mississippi). 1972. SEDIMENT, FISH, AND FISH HABITAT. J. Soil Wat. Conserv., 27(3): 124-125.

Sediment affects the fish and shellfish fauna of aquatic ecosystems. Under most conditions the ecological effect of sediment on aquatic ecosystems is probably greater than the physiological effect of sediment on fish. But the combination of ecological and physiological effects creates an additional stress on fish populations which tends to change these populations either in number or in dominant fish species, thereby altering original aquatic ecosystems.

15403. Rabkin, E. M., and R. A. Kudentsova (Gosudarstvennyi Nauchno-Issledovatelskiĭ Institut Ozernogo i Rechnogo Rybnogo Khozyaĭstva, Leningrad, USSR). 1969. PREPARATION OF SINGLE-LAYER TISSUE CULTURE FROM CRUCIAN CARP AND COMMON CARP GONADS. (Prigotovlenie Odnosloĭnoĭ Kul'tury Tkanei iz Gonad Karasya i Karpa). Available from National Tech. Information Service as PB-199 803-T, $3.00 in paper copy, $0.95 in microfiche. Translated from Veterinariya, Vol. 46, pp. 91-92; Selected Water Resources Abstracts, 5(13): p. 58, 1972.

Fish tissue cultures are required for study of fish diseases with a virological etiology. Of the large quantity of data available on the preparation and use of tissue cultures , only isolated reports are devoted to tissue cultures of fish. Preparation of a culture from mature carp ovaries is described. The organs were ground up, then dispersed with a 0.25% trypsin solution for 18-20 hr in cold, or for 30-45 min at room temperature. Centrifugation at 800-1000 rpm for 5-10 min was used to separate the cells from the trypsin and for washing. They were subsequently cultured on cover glasses in test tubes, using nutrient medium 199 with 10-15% calf serum. Crucian carp were maintained at 21-23C, and common carp cells at 25-27C. After seven days, the cells assumed an epithelium-like character.

15404. Parker, J. C. (Texas A&M Univ., College Station, Texas). 1971. CROAKER, Micropogon undulatus (Linnaeus), IN TWO GULF OF MEXICO NURSERY AREAS. Available from the National Tech. Information Service as COM-71 00778, $3.00 in paper copy, $0.95 in microfiche. Sea Grant Publication No. TAMU-SG-71-210, 182 p., 32 fig. 32 tab. 68 ref.; Selected Water Resources Abstracts, 5(13): p. 59, 1972.

The biology of the spot (Leiostomus xanthurus) and the Atlantic croaker (Micropogon undulatus) in the vicinity of Lake Borgne, Louisiana and of Galveston Bay, Texas is discussed relative to temperature, salinity, and certain hydrographic features. Geographic variations in spawning, growth rates, distribution and food habits were evaluated. Length-weight relationships were compared between the two areas. In Galveston Bay, condition of fish was studied relative to fish size, habitat, season of year, water temperature and salinity. Spot and croaker are in direct competition for food in both study areas. The degree to which this competition affects the abundance of these species is not known.

15405. Mashneva, N. I., and S. Ya. Sukal'skaya. 1971. KINETICS OF ACCUMULATION AND BIOLOGICAL ACTIVITY OF IODINE-131 DURING THE DEVELOPMENT OF WHITEFISH AND CARP. Hydrobiological Journal, 7(3): 29-34.

Experiments are reported which show that, in the range of 1×10^{-2}--2 millicuries/liter, the accumulation of I^{131} by eggs and larvae of whitefish and carp is independent of the concentration of radioisotope in the medium. The excretion of radioisotope from eggs and larvae proceeds at two independent rates. The harmful effect of I^{131} depends on the stage of embryogenesis at the onset of exposure to radiation.

15406. Knuckes, Joseph L. (Dept. of Biol. and Phys. Science, Fayetteville State Univ., Fayetteville, North Carolina). 1972. Ictalurus melas (Rafinesque), A NEW HOST FOR Argulus diversus (Wilson). J. Parasit., 58(3): p. 624.

15407. Shcherbina, M. A., and O. P. Kazlauskene. 1971. WATER TEMPERATURE AND THE DIGESTIBILITY OF NUTRIENT SUBSTANCES BY CARP. Hydrobiological Journal, 7(3): 40-44.

Studies are reported which show that in two-year-old carp, adapted for two weeks to a temperature of 16, 22 or 27°C, there is a tendency for the digestibility of most of the nutrient substances studied (crude protein, hydrolizable carbohydrates, crude cellulose, crude fat, macroelements) to decrease as the water temperature is increased in steps of 10°C (within the range studied).

15408. Balakhnin, I. A., and L. M. Romanov. 1971. DISTRIBUTION AND GENE FREQUENCY OF TRANSFERRIN TYPES IN STOCKBRED AND AMUR CARP. Hydrobiological Journal, 7(3): 75-77.

The types of transferrin in scaly, mirror, and leather stockbred carp and in the Amur carp were determined by electrophoresis of serum in starch gel using Gahne's method. The results of the experiments indicate that the mirror carp of the population under study have transferrin A. The serum of the scaly carp has heterozygotes AB and AC in addition to the homozygote A. The largest number of transferrin types was found in the leather carp - A, B, C, AB, and AC. There are differences not only in the distribution but also in the frequency of genes of the transferrin locus. For example, in the scaly carp the second most frequent gene after A is B, whereas in the leather carp the C gene is the most frequent. Among the stockbred carp investigated, the A phenotype is the most common while the BC phenotype is very rare. In contrast with the carp individuals examined, the serum of the Amur carp contained transferrin much less mobile than transferrin C. It has been designated transferrin D in accordance with the existing nomenclature. Its frequency in the Amur carp population was fairly high, about 64%. It accounts for a little over 10% of the gene of transferrin A, and most widespread in carp. Thus, the polymorphism of transferrins in the Amur carp is regulated by 4 genes (A, B, C, and D) with 10 possible phenotypes of which 8 have been found: B, C, D, AB, AC, AD, BD, and C. This is fairly good evidence of distinct differences between the common carp and Amur carp with respect to the transferrins.

15409. Uskova, Ye. T., A. V. Chaykovskaya, and I. A. Uskov. 1971. COMPOSITION OF AMINO ACIDS IN THE MUCUS OF FISH SKIN. Hydrobiological Journal, 7(3): 83-85.

Chromatograms of mucus obtained by removal from the fish skin with an air jet yielded only 9 spots which, according to the map of the standard amino acids, contained the following acids: α - alanine, serine, threonine, methionine, valine, aspartic acid, lysine, arginine, and glutamic acid. The chromatograph of the mucus removed by scraping with a scalpel contained 15 spots corresponding to 16 amino acids. The larger number found when the scalpel was employed was evidently due to the entry into the substance of epithelial cells, whose protein contains about 20 amino acids. The results indicate that fish slime consists of simple proteins. The demonstration that the mucus substance of fish skin has a fairly simple composition is of practical importance. It greatly simplifies the task of simulating the mucus coating on objects moving in water, and thereby helps to solve the problem of creating synthetic analogs.

15410. Komarova, T. I. 1971. PARASITES OF CARP LARVAE AND FRY IN THE UPPER REACHES OF THE KREMENCHUG RESERVOIR. Hydrobiological Journal, 7(3): 86-89.

The parasite fauna of young carp in the early stages of postembryonal development was studied. The material was collected in the upper part of the Kremenchug Reservoir. Twelve parasite species belonging to 6 systematic groups were found: Protozoa, 29.6%, Trematoda, 18.5%; Monogenea, 25.9%; Cestoda, 16.2%; Crustacea, 18.5%; Mollusca, 2.9%.

15411. Yoshino, Timothy P. (Dept. of Biol. Sci., Univ. of California, Santa Barbara, California.) 1972. HELMINTH PARASITISM IN THE PACIFIC KILLIFISH, Fundulus parvipinnis, FROM SOUTHERN CALIFORNIA. J. Parasit., 58(3): 635-636.

15412. Smith, Stanford H. (Great Lakes Fish. Lab., NMFS, Ann Arbor, Michigan). 1972. DESTRUCTION OF THE ECOSYSTEM IN THE GREAT LAKES AND POSSIBILITIES FOR ITS RECONSTRUCTION. "Progress in Fishery and Food Science", Univ. of Wash. Pubs. in Fish., New Series, Vol. 5, pp. 41-46.

This paper is a review of the sequence of events within the Great Lakes and their drainage to provide a basis for interpreting probable cause-and-effect relations between events of settlement and changes in the ecosystem of the Great Lakes. Possibilities of restoration of the lakes are discussed. A plan to do so must include (1) improvement of land uses in the drainage basin, (2) elimination of sources of physical, chemical, and biological pollution entering the lakes, and (3) restoration of favorable and productive fish populations. (Auth.)

15413. Shuttleworth, T. J. (Dept. of Zool., Univ. of Otago, Dunedin, New Zealand). 1972. A NEW ISOLATED PERFUSED GILL PREPARATION FOR THE STUDY OF THE MECHANISMS OF IONIC REGULATION IN TELEOSTS. Comp. Biochem. Physiol., 43(1A): 59-64.

A technique is described whereby individual gills are perfused at a known constant flow with a balanced Ringer solution. Using this technique, leaks as small as 0.2 $\mu l\ min^{-1}$ can be readily detected. Net fluxes of sodium, potassium and chloride have been measured in gills taken from eels adapted to fresh water and to sea water. Results indicate that the perfused gill preparation behaves, at least qualitatively, as it would in the intact fish. (Auth.)

15414. Lutz, Peter L. (Dept. of Zool., Univ. of Glasgow, Scotland). 1972. IONIC AND BODY COMPARTMENT RESPONSES TO INCREASING SALINITY IN THE PERCH Perca fluviatilis. Comp. Biochem. Physiol., 42(3A): 711-717.

The effect of osmotic and ionic stress on perch plasma, tissue and whole body electrolyte composition was studied. Perch survived indefinitely in bathing media up to 1/3 sea water (S.W.) in strength, with only K, Mg and Cl showing moderate significant rises in plasma, and in muscle only K and Ca being higher than the normal values in fresh water. As muscle water, chloride and sodium spaces and total body water are also maintained, a considerable degree of adaptive ionic regulation is indicated. All attempts to acclimate perch to 1/2 S.W. failed due to a breakdown of the ionic controlling mechanisms with all ions increasing greatly. Sodium and chloride invaded the muscle cells in large amounts and both muscle and whole body lost significant amounts of water. Liver tissue maintained its normal degree of hydration and the liver cells appeared relatively resistant to entrance by Cl. Mean increases point to the whole body being almost three times as permeable to Cl as Na in 1/2 S.W. (Auth.)

15415. Lutz, Peter L. (Dept. of Zool., Univ. of Glasgow, Scotland). 1972. IONIC PATTERNS IN THE TELEOST. Comp. Biochem. Physiol., 42(3A): 719-733.

The inter-relationships of ions in and between the major body compartments of Perca fluviatilis were studied. These are discussed individually in detail, but in particular Na and Mg were found to be the most tightly regulated of all ions and showed a highly significant inverse relationship in both plasma and cell. In tissue hydration water uptake was mainly by the cell with changes in the extracellular space playing a minor role. It is suggested that ionic levels in the body fluids are in a dynamic relationship with each other and function as precise controllers of specific and general metabolic processes. (Auth.)

15416. Smith, Albert C. (Div. of Nat. Sci., Univ. of Hawaii at Hilo, Hilo College, P.O. Box 1357, Hilo, Hawaii 96720). 1972. LENS ISO-PRECIPITIN IN YELLOWFIN TUNA (Thunnus albacares). Comp. Biochem. Physiol., 42(3B): 497-499.

Electrophoresis has been commonly used in the analysis of nuclear eye lens extracts for intraspecific variation. Experiments with extracts from yellowfin tuna indicate the presence of an iso-precipitin which may provide a simpler, but equally precise method. (Auth.)

15417. Atmar, Gerald L., and K. W. Stewart (Dept. of Biol. Sci., Kent State Univ., Stark County Campus, Canton, Ohio 44729). 1972. FOOD, FEEDING SELECTIVITY AND ECOLOGICAL EFFICIENCIES OF Fundulus notatus (CYPRINODONTIDAE). Amer. Midl. Nat., 88(1): 76-89.

Terrestrial arthropods formed 41% of the diet of field-collected blackstripe top minnow, with a consistent Electivity Index (E) value of positive-one; snails, aquatic insects and microcrustaceans, respectively, occupied 19%, 16% and 10% of the diet. Positive E values were maintained for aquatic insects, except in stagnant pools where interspecific fish competition probably occurred. Crustaceans assumed negative E values except in a single habitat, while snails took positive E values only in stagnant pools. Top minnows smaller than 38 mm, S.L., supplemented terrestrial arthropods with microcrustaceans for 28% of their ration; crustaceans decreased and aquatic insects increased in relative importance as fish size increased. Algae were ingested with 41% frequency, but apparently not digested. Fishes in feeding experiments showed a preference for chironomid larvae but an electivity for floating, terrestrial insects, which were readily available. Physid snails, with 42% frequency of occurrence in field-collected fishes, were avoided in the presence of abundant alternative prey. Assimilation efficiency was 97% for all size classes of top minnows. Top minnows of 48 to 65 mm S.L. had a lower ecological growth efficiency (5.9%) than smaller fishes (8.5%). The average daily energy expenditure for 48 to 65 mm fishes was lower, 20 cal x g of initial dry wt^{-1} (gWo^{-1}), than the 55 cal x gWo^{-1} for fishes smaller than 48 mm, S.L.; but the net efficiency of food utilization for growth in the latter (21.6%) was not significantly higher than that in 48 to 65 mm fishes (15.0%). Fundulus notatus facilitates the entrance of allochthonous organic material into the ecosystem by digesting and defecating the remains of terrestrial arthropods, and it indirectly taps the flow of matter and energy from allochthonous plant sources by preying upon aquatic insect detritus-feeders, getting more than one-half of its ration directly or indirectly from basically allochthonous sources. It also functions as a third- or fourth-level predator. (Authors)

15418. Wagner, Wilbert C., Thomas M. Stauffer, and Martin J. Hansen. 1972. LARVAL LAMPREY POPULATIONS IN A LAKE HURON BAY AND TRIBUTARY. Inst. for Fish. Res. Report No. 1785; Mich. Dept. of Natural Resources Research and Development Report No. 266, 32 p.

A stratified, random sampling technique was used to estimate the number of lamprey larvae in McKay Bay and McKay Creek during 1961-63. The total number of sea lampreys (Petromyzon marinus) was 32,926; 39% in the bay and 61% in the stream. This demonstrated that lenitic populations are large enough to warrant concern. Although our estimate showed that most lenitic larvae were on or near the alluvial fan where they could be eradicated with Bayluscide, nonrandom sampling revealed a substantial population some 1,400 feet from the stream mouth. This study confirms the need for continued, frequent larvicide treatments for certain streams. The American brook lamprey (Lampetra lamottei) population in our study area of McKay Creek was estimated at 130,808 and had a biomass of 352 pounds, or 30 pounds per acre. (Authors)

15419. Fryer, J. L., J. S. Nelson, and R. L. Garrison (Dept. of Microbiol., Oregon State Univ., Corvallis, Oregon). 1972. VIBRIOSIS IN FISH. Reprint from "Progress in Fishery and Food Science", Oregon State Game Comm., Portland, Oregon, Agricultural Exp. Sta. Tech. Paper No. 2879, Corvallis, Oregon, Vol. 5, pp. 129-133.

The etiology, pathology, and distribution of vibriosis in fish are reviewed. Control by means of the administration of drugs in the diet of fish is discussed. Peroral immunization of salmon with vaccine prepared from cells of Vibrio anguillarum is described. (Authors)

15420. FAO of the United Nations (Rome, Italy.). 1972. FAO AQUACULTURE BULLETIN. A QUARTERLY NEWS DIGEST OF AQUACULTURE RESEARCH AND DEVELOPMENT. FAO Aquacult. Bull., 4(3): 24 p. illus.

Text includes: From research institutions...Induced breeding of the sand goby

and rabbitfish - Induced spawning of gilt-head bream and sea bass - Crossbreeding of carps - Larval rearing techniques - Propagation of abalone - Fish feeds - Pelleted feeds from by-products - Shrimp culture - Cooperative research on catfish culture - Heat balance in ponds. Aquaculture development... Canada - Chile - Finland - France - Indonesia - Ivory Coast - The Netherlands - Nigeria - Norway - Philippines - Puerto Rico - United Kingdom - United States - Yugoslavia. Fish diseases and their control...Infectious pancreatic necrosis (IPN) in Scotland - Isolation of IPN virus from brook trout - UDN in Europe - Whirling disease in Colombia - Ichthyophthiriasis, dactylogyrosis and dropsy in Nepal - Cestodes in the intestines of Clarias in Central African Republic - Lernaeasis in Indonesia. Fish and shellfish introductions...Recent introductions - Results of salmonid introduction in Kerguelen Islands. (From contents)

15421. Latta, W. C. 1972. THE EFFECTS OF STREAM IMPROVEMENT UPON THE ANGLERS' CATCH AND STANDING CROP OF TROUT IN THE PIGEON RIVER, OTSEGO COUNTY, MICHIGAN. Inst. for Fish. Res. Report No. 1786; Mich. Dept. of Natural Resources Research and Development Report No. 265, 57 p.

A comparison of the "before" years (1949-53), with the "during" years (1954-58), and the "after" years (1960-64), for catch and standing crop, showed a consistent increase of brook trout for the years (1954-58) when improvement structures were in the Pigeon River. However, for the brown trout there appeared to be a steady increase throughout the three time periods, independent of the addition or removal of structures. For brook trout, a statistically significant increase occurred in numerical catch, in fall standing crop (pounds), in fall standing crop plus catch (pounds), and in numbers of age-I and older fish. Fishing pressure remained constant for the during (1954-58) and after (1960-64) years. The increase in brook trout as recorded in catch and standing crop must be attributed either to better survival or to migration of trout in response to the addition of cover.

15422. Stevens, E. Don, and F. E. J. Fry (Dept. of Zool., Univ. of Hawaii, Honolulu, Hawaii 96822). 1972. THE EFFECT OF CHANGES IN AMBIENT TEMPERATURE ON SPONTANEOUS ACTIVITY IN SKIPJACK TUNA. Comp. Biochem. Physiol., 42(3A): 803-805.

The spontaneous activity of skipjack tuna tended to remain unchanged in the face of a gradual decrease in ambient temperature from 24 to 16°C. One fish cooled further showed a rapid decline in activity at 14°C and died at 13°C. (Authors)

15423. Tyler, A. V. (Fish. Res. Bd. of Canada Biol. Sta., St. Andrews, New Brunswick, Canada). 1972. FOOD RESOURCE DIVISION AMONG NORTHERN, MARINE, DEMERSAL FISHES. J. Fish. Res. Bd. Canada, 29(7): 997-1003.

The division of food resources among 13 demersal fishes was examined over a 16-month period in an area of Passamaquoddy Bay, New Brunswick. Though over 100 prey species were found in the stomachs of the predators, each predator took only three or four principal prey, and these prey made up 70-99% of the mass of the food for each predator species. Which species that a predator took as principal prey depended on prey body size, whether the prey were nekton, epi-fauna, or infauna; and whether or not they had a hard test or shell. Within predator species there was significant heterogeneity in diet related to size of predator individual. The seasonal predators did not feed as a group on their own set of prey species. Most principal prey species of the seasonal predators were taken simultaneously by one or two of the regulars. Data were compared with published results from two other northern marine areas. Within Irish Sea, Sea of Okhotsk, and Passamaquoddy winter and summer communities, only 10-24% of the possible recurrences of principal prey among predators actually occurred, i.e. there was relatively little overlap among diets. Such specialization would have adaptive significance in food-limited production system.

15424. Horak, Donald L. (Colo. Game, Fish and Parks Div., Fort Collins, Colorado 80521). 1972. SURVIVAL OF HATCHERY-REARED RAINBOW TROUT

(Salmo gairdneri) IN RELATION TO STAMINA TUNNEL RATINGS. J. Fish. Res. Bd. Canada, 29(7): 1005-1009.

No conclusive evidence was found in tests from 1966 to 1969 in either lentic or lotic environments to support the hypothesis that hatchery-reared rainbow trout (Salmo gairdneri) with a high-stamina index had a higher survival potential than those whose stamina index was low. Physical stamina was measured by determining the length of time each fish could withstand sustained swimming in a specially constructed stamina tunnel. For high-stamina rating, fish swam in the tunnel for 80 min; for low stamina, 1-10 min. In tests of reproducibility of stamina ratings, improved swimming ability of low-stamina fish was demonstrated upon retesting in the tunnel. In 1970, with retested fish, still no evidence was found to indicate higher survival of fish rated as high in stamina. Additional studies are needed to determine if performance of hatchery-reared salmonids in a stamina tunnel is a valid indicator of their survival potential in the wild. (Auth.)

15425. Carlson, H. Richard, and R. E. Haight (NMFS Auke Bay Fish. Lab., Auke Bay, Alaska 99821). 1972. EVIDENCE FOR A HOME SITE AND HOMING OF ADULT YELLOWTAIL ROCKFISH, Sebastes flavidus. J. Fish. Res. Bd. Canada, 29(7): 1011-1014.

Existence of a home site and homing ability was established for adult yellowtail rockfish, Sebastes flavidus (Ayres). Fish returned to the home site from as far as 22.5 km, some after displacement to other schools of the species and some after 3 months in captivity. Stretches of deep open water appeared to pose a hindrance to homing. Intensive fishing of a localized adult stock could cause a long-term decline in its abundance. (Authors)

15426. Kabata, Z., and B. Cousens (Fish. Res. Bd. of Canda Pacific Biol. Sta., Nanaimo, British Columbia, Canada). 1972. THE STRUCTURE OF THE ATTACHMENT ORGAN OF LERNAEOPODIDAE (CRUSTACEA: COPEPODA). J. Fish. Res. Bd. Canada, 29(7): 1015-1023.

The morphology and the anatomy of the bulla, a unique attachment organ of the parasitic copepods belonging to Lernaeopodidae (Caligoida) is described. By their anatomy the bullae can be divided into three types, associated with three groups of fishes: freshwater teleosts, marine teleosts, and elasmobranchs. The evolution of Lernaeopodidae is briefly outlined. The authors point out that the type of the bulla appears independent of the phylogenetic position of the parasite but is related only to the type of the host. It is concluded that the bulla is more than an attachment organ and that it enters into physiological association with the tissues of the fish. (Authors)

15427. Madison, D. M., R. M. Horrall, A. B. Stasko, and A. D. Hasler (Lab. of Limnol., Univ. of Wis., Madison, Wisconsin 53706). 1972. MIGRATORY MOVEMENTS OF ADULT SOCKEYE SALMON (Oncorhynchus nerka) IN COASTAL BRITISH COLUMBIA AS REVEALED BY ULTRASONIC TRACKING. J. Fish. Res. Bd. Canada, 29(7): 1025-1033.

Individual courses, obtained by ultrasonic tracking nine sockeye in 1969 and nine in 1970, ranged up to 130.8 km (24.2 median) and 66.6 hr (9.6 median). Course directions were mainly to the north and west in 1969 and to the south and east in 1970. This difference may have arisen from differences in home river affiliation of the tracked sockeye. Swimming speeds showed a pronounced diel rhythm with higher values at 1400 hr and lower values at 0200 hr. The average speed of 53 cm/sec was consistent with rate of movement estimates obtained previously from tagging-recapture studies. A 13 cm/sec greater average speed in 1970 than in 1969 was observed, and possible reasons for the difference were discussed. Differences in speed within or beyond 2 km from land were not observed for either year. A diel rhythm in the magnitude of course change appeared, with a decrease in the frequency of large angular changes occurring in the afternoon. An orientation mechanism involving a daily reorientation process is hypothesized. (Authors)

15428. Gillespie, D. C. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1972. MOBILIZATION OF MERCURY FROM SEDIMENTS INTO GUPPIES (Poecilia reticulata). J. Fish. Res. Bd. Canada, 29(7): 1035-1041.

Guppies (P. reticulata) were exposed in aquaria to aerobic and anaerobic sediments to which various forms of mercury were added and to sediments from two sites of industrial pollution. Whole body levels of total mercury (atomic absorption analysis) in these fish were used as a measure of mobilization of mercury from these sediments. Spot checks for methylmercury were carried out at intervals during the tests. Under aerobic conditions there was little mobilization of mercury from sediments to which mercuric chloride or sulphide had been added but total mercury concentrations rose rapidly in fish exposed to sediments containing metallic mercury. The proportion of methylmercury in fish reached maxima of 30% for metallic mercury, 40% for mercuric chloride, and 45% for mercuric sulphide. In anaerobic sediments, total mobilization was low and only mercuric chloride was significantly methylated (40% of the total in the fish). Both mobilization and methylation were proportionately greater in industrial sediments with a low mercury content than in sediments with a higher mercury content. Enrichment of sediments with lignosulphonate showed no real effects aerobically, possibly because of the chelation properties of the preparation used. Anaerobically, lignosulphonate stimulated methylation of mercury. The levels of mercury and methylmercury found in fish are consistent with data from nature. Some of the implications of the results are discussed. (Auth.)

15429. Kelso, J. R. M., and F. J. Ward (Dept. of Zool., Univ. of Manitoba, Winnipeg 19, Manitoba, Canada). 1972. VITAL STATISTICS, BIOMASS, AND SEASONAL PRODUCTION OF AN UNEXPLOITED WALLEYE (Stizostedion vitreum vitreum) POPULATION IN WEST BLUE LAKE, MANITOBA. J. Fish. Res. Bd. Canada, 29(7): 1043-1052.

The population of walleye, Stizostedion vitreum vitreum, (25 cm and greater) in West Blue Lake, Man., in May 1969 decreased from 1090 to 819 in May 1970. During summer and fall, the initial population was supplemented by new recruits, age II^+, reaching a maximum of 3451 in September 1969. The total population in May 1970 was 2037. Mean daily mortality for all ages was small for the year, 0.0045, but loss rate was greatest in fall and winter. Growth in length was greatest for age II^+ followed by older fish. Growth in weight was similar for ages III-V and lowest for age II^+. Mean biomass, approximately 800 kg, was similar in May 1969 and May 1970. Production, 340 kg, coincided with the growing season (June to October) and was greatest from June to September. Greatest contribution to walleye production and biomass was made by age II^+ fish. During winter and spring, zero or negative production occurred. (Authors)

15430. Scott, K. R., and D. C. Gillespie (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1972. A COMPACT RECIRCULATION UNIT FOR THE REARING AND MAINTENANCE OF FISH. J. Fish. Res. Bd. Canada, 29(7): 1071-1074.

The use of a compact recirculation system for rearing rainbow trout is described. An 8-month experiment showed that up to 75 kg of fish could be maintained in a healthy condition in a 1600-liter tank using a make-up water rate of only 1.0 liter/min. Temperature, oxygen, pH, ammonia nitrogen, and nitrate nitrogen levels were satisfactorily controlled. An average weight gain of 8% per week was achieved with a feed rate of 2% of body weight per day. Fish mortality was insignificant. (Authors)

15431. Fulton, John (Fish. Res. Bd. Canada, Biol. Sta., Nanaimo, British Columbia, Canada). 1972. TRIALS WITH AN AUTOMATED PLANKTON COUNTER. J. Fish. Res. Bd. Canada, 29(7): 1075-1078.

An opto-electronic plankton counter-sizer counted samples of zooplankton in seven size classes about six times faster, with greater precision and likely greater accuracy than human sorters. Samples used in the trials were of low diversity, and dominant taxa in each of the seven size classes could be quickly identified

under a low-power microscope before machine counts were made. Sample concentrations of less than 3000 organisms per liter were found to be optimal for machine counting. In samples of greater concentration, coincident passage of two or more small organisms caused a bias in favor of the larger size classes. (Auth.)

15432. Scott, K. R. (Fish. Res. Bd. Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1972. TEMPERATURE CONTROL SYSTEM FOR RECIRCULATION FISH-HOLDING FACILITIES. J. Fish. Res. Bd. Canada, 29(7): 1082-1083.

The self-contained conditioning unit included heating, refrigeration, filtration, and aeration devices on a caster-mounted frame. Heating and cooling were performed in a stainless steel combination cooler-heater unit. Heating is produced by an electric resistance element and cooling by a water-cooled hermetic refrigeration compressor. Temperatures were maintained within $\pm$ 0.06 C degree of set point between 2 and 20 C in two 200-gal tanks using a modulating electronic temperature controller. (Auth.)

15433. Thorson, K. N. (NMFS, Exploratory Fishing and Gear Res. Base, Seattle, Washington 98102). 1972. SUBCUTANEOUS HEMORRHAGE IN CAPTIVE SABLEFISH (Anoplopoma fimbria): A POSSIBLE LINK TO MORTALITY. J. Fish. Res. Bd. Canada, 29(7): 1089-1090.

During the spring of 1971 two groups of sablefish (Anoplopoma fimbria) were captured by pot fishing gear off the Washington coast. Within three days subcutaneous hemorrhages occurred in both groups and the more extensively hemorrhaged fish soon died. It appeared that the hemorrhages were a delayed reaction to injury sustained at capture. Impact against the pot walls or embolism arising from rapid decompression are suggested as possible causes. (Auth.)

15434. Clifford, Hugh F. (Dept. of Zool., Univ. of Alberta, Edmonton, Alberta, Canada). 1972. DOWNSTREAM MOVEMENTS OF WHITE SUCKER, Catostomus commersoni, FRY IN A BROWN-WATER STREAM OF ALBERTA. J. Fish. Res. Bd. Canada, 29(7): 1091-1093.

In a brown-water stream of Alberta, white sucker (Catostomus commersonii) fry moved downstream almost entirely at night. During June and July when the fry were moving downstream, their nocturnal "droft" pattern was more pronounced than that of any of the drifting invertebrates; and at this time their total biomass crossing a width transect per 24 hr exceeded the combined total biomass of the drifting invertebrate taxa. As the fry became larger, many more moved downstream near the surface of the water than near the stream's substrate. (Auth.)

15435. Reinboth, Rudolf (Inst. für Allgem. Zool., Johannes Gutenberg Univ., Mainz, Germany). 1972. HORMONAL CONTROL OF THE TELEOST OVARY. American Zoologist, 12(2): 307-324.

The endocrine basis of gonadal development, reproductive processes, and many peculiarities related to reproduction in females of the highly diversified teleosts cannot yet be described satisfactorily. Although estrogens have been extracted from ovaries and peripheral blood of several species and various steroids were found to be produced by ovarian tissue in vitro, there is an almost complete lack of knowledge about their physiological role. It is beyond any doubt that hormones of the pituitary have a marked influence on ovarian maturation but many problems await further clarification. It is not yet clear whether gonadotropic hormones might have a direct influence on certain traits of behavior in females. Biochemical work and a large number of histophysiological studies are at variance with regard to the question whether one or two gonadotropic hormones exist in teleosts. Technical difficulties (e.g., shortage of hormonal material from various sources, species specificity of gonadotropic hormone(s), widely scattered data from a large array of species with considerable differences in reproductive biology) hamper comparative analysis. Investigations on the hypothalamic control of endocrine events are just in their beginning. The unique occurrence of ambisexual species in teleosts raises many questions which remain to be solved. (Auth. synopsis)

15436. Vermeer, Kees (Canadian Wildl. Serv., Edmonton, Alberta, Canada). 1972. THE CRAYFISH, Orconectes virilis, AS AN INDICATOR OF MERCURY CONTAMINATION. Canad. Fld Nat., 86(2): 123-132.

The crayfish, Orconectes virilis, is a good indicator of mercury contamination in different water bodies. Crayfish muscle contained three times as much mercury as the remaining body. Mercury levels did not differ significantly in samples collected from various parts of the shore of a highly contaminated lake. (Auth.)

15437. Sokolov, P. M. and N. G. Maslyukova. 1971. THE USE OF MALACHITE GREEN IN GYRODACTYLESIS OF CARP (Primenenie Malakhitovogo Zelenogo pri Girodaktileze Karpov). Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Prudovogo Rybnogo Khozyaĭstva, Vol. 18, pp. 179-180; U. S. Dept. of the Interior Report SFWFR-TR-73-01, 2 p. Translated by Robert M. Howland.

Malachite green was used successfully at a concentration of 0.16 mg/l with an exposure time of 25 hours to control gyrodactylesis of carp in wintering ponds.

15438. Muzykovskiĭ, A. M. 1971. THE TESTING OF PHENASAL IN BOTHRIOCEPHALESIS OF CARP (Ispytanie fenasala pri botriotsefaleze karpov). Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Prudovogo Rybnogo Khozyaĭstva, Vol. 18, pp. 146-148; U. S. Dept. of the Interior Report SFWFR-TR-73-02, 5 p. Translated by Robert M. Howland.

Phenasal was tested to determine its antihelminthic qualities. Experiments in tanks and ponds showed that after single administration of the drug the extense-effectiveness was 41%, and the intense-effectiveness - 36.5%.

15439. Grishchenko, L. I. 1971. CLINICO-ANATOMICAL CHARACTERISTICS OF INFLAMMATION OF THE SWIMBLADDER OF CARP. (Kliniko-anatomicheskaya kharakteristika vospaleniya plavatel'nogo puzyrya karpov). Trudy Vsesoyuznogo Nauchno-Issledovatel'skogo Instituta Prudovogo Rybnogo Khozyaĭstva, Vol. 18, pp. 46-51; U. S. Dept. of the Interior Report SFWFR-TR-73-03, 9 p. Translated by Robert M. Howland.

In making diagnosis of inflammation of the swimbladder of carp it should be kept in view that in the acute course of the disease the leading symptom is serous-hemorrhagic or in the case of complication purulent inflammation of the swimbladder. In the chronic form on the first plane, serous edema and necroses of the bladder wall appear. Considering the fact that the changes in the swimbladder and, especially, in the parenchymatous organs are not strictly specific, the diagnosis of inflammation of the swimbladder must be established on the basis of complex investigations (epizootological, clinical, pathologo-morphological).

15440. Wahtola, C. H., Jr., D. E. Miller and J. B. Owen (Dept. of Biology, Univ. of No. Dakota, Grand Forks, North Dakota 58201). 1972. THE AGE AND RATE OF GROWTH OF WALLEYE (Stizostedion vitreum) AND SAUGER (Stizostedion canadense) IN LAKE SAKAKAWEA, NORTH DAKOTA, 1968-1969. Proc. of the No. Dakota Acad. of Sci., Vol. 25, pp. 72-83.

The age and growth rate of walleye, Stizostedion vitreum (Mitchill), and sauger, S. canadense (Smith), in Lake Sakakawea, North Dakota, were investigated during the summers of 1968 and 1969. A total of 236 walleye and 447 sauger were captured during the study. Scales were taken, and annual growth was back calculated. The maximum age of walleye was 10 years; that of saugers was 7 years. The overall sex ratio for walleye was 1.54 females per male whereas sauger had a ratio of 0.87 females per male. The overall coefficient of condition was 0.86 for walleye, and 0.73 for sauger. Walleye from Lake Sakakawea have good linear growth when compared with walleye from waters in the north-central United States but not as good as walleye from Norris Reservoir, Tennessee. Sauger from Lake Sakakawea had somewhat slower growth than those from Lake of the Woods, Lake Winnipeg and Lake Erie. Good growth rates were attributed to an abundance of small goldeye, Hiodon alosoides (Rafinesque), and yellow perch, Perca flavescens (Mitchill). (Authors)

15441. Lebedinskiĭ, N. A. (Inst. of Hydrobiol. of the AS USSR, Kiev, USSR). 1970. TOWARD THE QUESTION ON THE EFFECT OF LOW CONCENTRATIONS OF PHENOL ON CHANGE IN THE AMOUNT OF MICROELEMENTS IN THE CARP. (K voprosu o vliyanii malykh kontsentratsiĭ fenola na izmenenie kolichestva mikroélementov u karpa). Voprosy Vodnoĭ Toksikologii, AN SSSR, "Nauka", Moscow, 181-183. Translated by Robert M. Howland.

Such a relatively low concentration of phenol as 0.1 mg/l, with prolonged influence on carp leads to marked changes in the amount of manganese, copper, iron, lead, strontium and aluminum in the blood, muscles and skeleton. This indicates that in mobilization of the protective forces of the organism, which are directed toward the counteraction of phenol intoxication, redistribution of the quantity of these microelements in the blood and other tissues occurs. The lack of substantial changes in the concentration of the above-named microelements in the skin indicates that at such a phenol concentration the skin apparently still does not show its barrier function completely. (Auth.)

15442. Morita, Shou, and Tadashi Kitahara. 1971. PRELIMINARY EXPERIMENTS ON THE AMOUNT OF CAROTENOID PIGMENT IN MATURED EGGS OF HERRING, AND SOME CONSIDERATIONS ON THE QUALITY OF THE EGGS. Bull. Hokkaido Reg. Fish. Res. Lab., 37: 1-9. In Japanese with English abstract.

A preliminary experiment was made in order to verify the hypothesis that the survival of larval herring was influenced not only by natural causes but by the quality of the eggs. In each herring stock of Okhotsk and Alaska, the amount of carotenoid pigment as an index of quality of the matured eggs was measured. By analysis mainly of the absorption spectral curves with the spectrophotometer, it was determined that carotenoid in herring eggs consisted only of lutein. The amount of lutein in the eggs of Okhotsk herring was much more than that of Alaska herring. Meanwhile, as is well known, the growth rate of Far East herring is generally higher than that of those off North America. Therefore it appears that the food environment for adult herring is considerably different in each area, because carotenoid pigment is not compounded in the fish body but gotten with the food. In Okhotsk herring, it is evident that the older the fish, the more the amount of lutein in the eggs. In this report, the authors discuss "better" eggs for survival. As a result it is felt that more research is necessary on the quality of eggs and the nutritional condition of parent herring. Also, a correlation is necessary between these two and the survival of larval herring. (Authors)

15443. Timm, T. 1962. ON THE DISTRIBUTION OF OLIGOCHAETE WORMS (OLIGOCHAETA) IN THE LAKES OF ESTONIA. (O rasprostranenii maloshchetinkovykh chervei (Oligochaeta) v Ozerakh Éstonii). Gidrobiologicheskie issledovaniya III, Institut Zoologii i Botaniki Akademii Nauk Éstonskoĭ SSR, pp. 162-168. Translated from the Russian by Robert M. Howland.

Data collected on the expeditions of the Institute of Zoology and Botany of the Academy of Sciences of the Estonian SSR and the Department of Zoology of Tartu State University in 1951-1958, as well as personally by the author in 1956-1958, are utilized in the report. In all, the oligochaetes from 580 different samples, pertaining to 183 lakes, were examined (Lake Peipus is not considered here). In view of the considerable dividedness of the material it is possible to characterize only the fauna of certain groups of lakes, but not individual bodies of water.

15444. Wedemeyer, Gary (Western Fish Disease Lab., Bur. of Sport Fish. & Wildl., Sand Point Naval Support Activity, Seattle, Washington). 1972. ENVIRONMENTAL CONTAMINATION BY PERSISTENT PESTICIDES. "Progress in Fishery and Food Science". Proc. 50th Anniv. Symp. Coll. of Fisheries, Univ. of Washington Press, pp. 69-75.

Pesticides have become almost essential for needed food production and for certain types of disease control, but their imprudent use in the past has resulted in their widespread presence in the earth's soil and water and thus in man's food supply. As one result, humans and other animals now carry a body burden of chlorinated hydrocarbon pesticides, the chronic effects of which will not become clear for decades. These and other problems of pesticide usage are discussed in terms of occurrence, persistence, and ultimate fate in the environment. (Auth.)

15445. Yasunaga, Yoshinobu. 1971. THE STUDIES ON DIGESTIVE FUNCTION IN FISH - I. PEPTIDASE ACTIVITY IN THE TISSUES OF THE DIGESTIVE TRACTS OF YELLOWTAILS. Bull. Tokai Reg. Fish. Res. Lab. No. 65, pp. 5-10. In Japanese with English abstract.

In order to research the digestive functions of yellowtail, one of the typical carnivorous fish, the author examined the tissue structure of their digestive tracts using the histological method and peptidase activity using the histochemical method. The histological findings were that: there seems to be gland-like tissue in the esophagus, which is similar to the esophageal gland in mammals and consists of many mucilage cells; the pyloric portion of the stomach lacks the gastric gland; the intestinal tissue is the same throughout the whole gut; the pyloric caecum is nearly the same with the intestine. The results of histochemical test showed that: there is no peptidase activity in the tissues of the esophagus; fairly strong peptidase activity in the gastric gland of the stomach and a little in the muscularis mucosae; large parts of the guts also show strong peptidase activity especially in the villus; pyloric caeca do the same as in the intestine. It is still questionable whether all the peptidase activity in the results means a direct relation to the digestive functions of the fishes.

15446. Nicholson, William R. (NMFS, Atlantic Estuarine Fish. Center, Beaufort, North Carolina 28516). 1972. POPULATION STRUCTURE AND MOVEMENTS OF ATLANTIC MENHADEN, Brevoortia tyrannus, AS INFERRED FROM BACK-CALCULATED LENGTH FREQUENCIES. Chesapeake Science, 13(3): 161-174.

As part of a continuing program begun in 1955, catches of Atlantic menhaden, Brevoortia tyrannus, were sampled for age and length at reduction plants from Florida to Massachusetts. For the years 1955-1964, lengths at the time of first annulus formation were back-calculated from age-1, -2, and -3 menhaden collected at at each port. Length frequency distributions, derived from monthly and seasonal totals were plotted for the 1953-1963 year classes. Meristic data on population structure were reviewed. General conclusions drawn from these and other supporting data were (1) mixing of menhaden of all ages from all areas occurs south of Cape Hatteras, North Carolina, during the winter, (2) at the time of first annulus formation in early spring, age-1 menhaden segregate along the coast by size, which increases from south to north, (3) all menhaden do not return to the same area they occupied the previous year, (4) for normal year classes, recruitment into the fishable population may not be complete until late in the second summer of life (age-1); for exceptionally large year classes recruitment may not be complete until the beginning of the third summer (age-2), and (5) Atlantic menhaden constitute a single homogeneous population, rather than two or more subpopulations as previously hypothesized. (Auth.)

15447. Batts, Billy S. (Dept. of Natural Sciences, Longwood Coll., Farmville, Virginia 23901). 1972. FOOD HABITS OF THE SKIPJACK TUNA, Katsuwonus pelamis, IN NORTH CAROLINA WATERS. Chesapeake Science, 13(3): 193-200.

Food habits of the skipjack tuna, Katsuwonus pelamis, were determined for specimens collected from the Hatteras and Oregon Inlet charter boat fishery. Stomach content analysis showed 55% empty stomachs. Fishes, mollusks, and crustaceans were consumed by the skipjack tuna. Fishes were the most frequent food item at both Hatteras and Oregon Inlet, followed by mollusks and crustaceans at Hatteras and by crustaceans and mollusks at Oregon Inlet. At Hatteras, fishes constituted 90% of the food by volume, with mollusks and crustaceans contributing 7 and 3%, respectively. At Oregon Inlet, mollusks and fishes were about equal in volume, with crustaceans contributing about 1%. As skipjack tuna increased in length the volume of crustaceans decreased and the volume of mollusks increased. There was a tendency for fishes to be less important and mollusks to be more important as length increased. (Auth.)

15448. Apazidi, L. Kh. 1959. DEVELOPMENT OF THE FUNGUS-AGENT OF BRANCHIOMYCOSIS OF THE FISH. (Razvitie Griba-Vozbuditelya Brankhiomikoza Ryb). Veterinariya, 39(6): 37-39. Translated by Robert M. Howland.

15449. Gilmour, R. Stewart, and Gordon H. Dixon (Dept. of Biochem., The Univ. of British Columbia, Vancouver 8, Canada). 1972. BIOSYNTHESIS OF PROTAMINE IN TROUT TESTIS. V. In Vitro SYNTHESIS OF PROTAMINE IN A TROUT LIVER CELL-FREE SYSTEM. J. Biol. Chem., 247(14): 4621-4627.

A cell-free protein-synthesizing system from rainbow trout liver can initiate de novo synthesis in the presence of exogenous messenger RNA if the system is previously incubated for 60 min. Polyuridylic acid and polyguanylic uridylic acid can be used as synthetic messenger RNA to test for the ability of the system to reinitiate synthesis. Low molecular weight RNA isolated from protamine stage testis microsomes actively stimulates the incorporation of [^{14}C]arginine and [^{35}S]methionine into acid-insoluble material. Starch gel and polyacrylamide gel fractionation show that both isotopes are incorporated in vitro into protamine and histone. The protamine product was characterized by separately incorporating [^{14}C]arginine, [^{14}C]proline, and [^{14}C]serine into in vitro synthesized material and carrying out ten sequential Edman degradations. The order of appearance of labeled amino acids during this process was consistent with the known sequence of rainbow trout protamine. Most of the in vitro [^{35}S]methionine incorporation into protamine was found to be NH_2-terminal. Electrophoresis of a tryptic digest of this material showed that methionine occurred in a basic peptide with the same mobility as that previously found with in vivo methionine-labeled protamine. Methionine appears to be involved both in the in vitro and in vivo initiation of protamine synthesis. A substantial proportion (45%) of the [^{35}S]methionine incorporated into histone was also found to be NH_2-terminal. (Authors summ.)

15450. Mehrle, Paul M., Mary E. DeClue, and Richard A. Bloomfield (Fish-Pesticide Res. Lab., Bur. of Sport Fish. & Wildl., Columbia, Missouri 65201). 1972. PHENYLALANINE METABOLISM ALTERED BY DIETARY DIELDRIN. Nature, 238(5365): 462-463.

Dieldrin has a marked effect on phenylalanine metabolism and can induce the biochemical manifestations of phenylketonuria; however, the effects of dieldrin on learning ability in fish remain to be elucidated. The results from this study are indicative of subtle, chronic effects of dieldrin that may alter the adaptability and survival of rainbow trout.

15451. Cairns, John, Jr., Kenneth L. Dickson, and John S. Crossman (Biol. Dept. and Center for Environ. Studies, Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia). 1972. THE RESPONSE OF AQUATIC COMMUNITIES TO SPILLS OF HAZARDOUS MATERIALS. Proc. of the 1972 National Conf. of Hazardous Material Spills, pp. 179-197.

From the four case 'history studies' presented it appears that the biological recovery of damaged rivers is a function of the physical, chemical, and biological characteristics of the receiving stream, the severity and duration of the stress, and the availability of undamaged areas to serve as sources for recolonizing organisms. Short term acute stresses produced by the release of acidic or caustic materials into a receiving stream elicit a response pattern in the macroinvertebrate and fish communities typified by an immediate reduction in the number of specimens. When no residual toxicity is found and there are undamaged areas available to act as sources for recolonizing organisms, a rapid recovery may be expected. Mill Creek had such a recovery when a small (100 foot) section of the creek was experimentally treated with acid immediately below an undamaged headwater area. By comparison, the biological recovery of the Clinch River from the acute pH stresses has been somewhat slower due to the severity and the extent of the biological damage. A long term acute stress and stresses from materials with residual toxicities produce a similar but slightly different response pattern. Just as in short term acute stress situations, the general response pattern is an immediate reduction in both diversity (number of species) and density. However, with residual toxicities the macroinvertebrate organisms that survive the stress seem to be able to establish an interim type of community structure which lasts as long as the toxicity persists. The rate of recolonization of damaged areas seems to be dependent upon 1) the distance an area is located from the site of the original spill and 2) the existence of undamaged tributaries. Those areas immediately below

the site of the Clinch River spills were the first to show recovery. Reaches of the river further downstream were slower to recover. The rate of recovery is also faster below healthy tributaries as shown in the Indian Creek study.

15452. Bayliff, William H., and Lars M. Mobrand. 1972. ESTIMATES OF THE RATES OF SHEDDING OF DART TAGS FROM YELLOWFIN TUNA. Inter-American Tropical Tuna Comm. Bull., 15(5): 441-462.

Return data for single-tagged fish and for double-tagged fish which had retained one or both tags were used to estimate the rates of shedding of dart tags from yellowfin tuna. The Type-1 shedding, which occurs immediately after release of the fish, is about 10 percent. The Type-2 shedding is assumed to be constant throughout the life of the fish after tagging; it occurs at an instantaneous rate of about 0.278 per year. (Authors)

15453. Ivanov, A. P., R. Ya. Kosyreva, and N. L. Nechaeva (VNIRO, USSR). 1972. NEW METHODS OF SANITIZING SALMONID PISCICULTURAL PLANTS. (Novye Metody Ozdorovleniya Lososevykh Rybovodnykh Zavodov). Rybnoe Khozyaistvo, No. 5, pp. 18-20. In Russian.

The survival of salmon fry with the use of bactericidal apparatuses increased by two times under experimental conditions. Bactericidal installations with ultraviolet lamps of sufficient power can be used for the liquidation of costiasis and gyrodactylesis.

15454. Moskalev, A. A. (Gidroproekt, USSR). 1972. TOWARD THE QUESTION ON THE FACTORY PROPAGATION OF THE SALMON IN THE PECHORA BASIN. (K Voprosu o Zavodskom Razvedenii Semgi v Basseine Pechory). Rybnoe Khozyaistvo, No. 5, pp. 20-21. In Russian.

A proposal is made to establish artificial propagation of the autumn salmon of the Pechora River, since its natural spawning sites have been reduced greatly due to hydroelectric facilities and pollution of tributaries.

15455. Coppage, D. L., and T. W. Duke (U. S. Environ. Protection Agency, Office of Research and Monitoring, Gulf Breeze Lab., Sabine Island, Gulf Breeze, Florida 32561). 1971. EFFECTS OF PESTICIDES IN ESTUARIES ALONG THE GULF AND SOUTHEAST ATLANTIC COASTS. Proc. of the 2nd Gulf Coast Conf. on Mosquito Suppression and Wildl. Mgmt., New Orleans, Louisiana, October 20-22, 1971, pp. 24-31, 36 references.

Examples of persistent pesticides found in water, sediment, oysters, and fish in Gulf and Southeast Atlantic estuaries are reviewed and research on effects of a less persistent organophosphate pesticide is presented. Results of some field and laboratory studies of effects of persistent pesticides on estuarine biota are reviewed. The neurotoxic effects of pesticides are discussed and the in vivo inhibitory effects of malathion on fish brain acetylcholinesterase (AChE) are demonstrated. The in vivo inhibitory effects on AChE of three estuarine fish species from an area sprayed with organophosphate pesticide are shown. The fish brain AChE inhibition is correlated with mosquito control operations. (Authors)

15456. Voronin, F. N., and Z. N. Rusetskaya (Byelorussian State Univ., USSR). 1971. DETERMINATION OF THE AGE AND GROWTH OF THE EUROPEAN FRESHWATER EEL [Anguilla anguilla (L.)] FROM THE SCALES. Journal of Ichthyology, 11(5): 717-724.

Scales appear on the eel in the first year of life in fresh water at a body length of 14-18 cm. Small scales taken at the same place on the body of the eel have an identical number of rings. The layering of annuli on the scales of the eel follows the same pattern as the annuli of other species of fish. The scales of the eel are an excellent subject not only for the determination of age and empirical growth, but also for study of the growth by the method of back calculation. Comparative data on the growth of the eel in the lakes of Byelorussia and other bodies of water are given in the paper.

15457. Cooper, W. A., R. S. Hestand, III, and C. E. Newton (West Texas State Univ., Canyon, Texas). 1971. CHEMICAL LIMNOLOGY OF A DEVELOPING RESERVOIR (LAKE MEREDITH) IN THE TEXAS PANHANDLE. The Texas Journal of Science, 23(2): 241-251; Selected Water Resources Abstracts, 5(14): p. 49.

The sparcity of limnological data for reservoirs in Texas prompted determination of continuing chemical data for Lake Meredith, an impoundment on the Canadian River in the Texas panhandle. The physical and chemical history of the water of the lake from the closure of the dam in February 1965, until the last of December 1968, is presented. Watershed data and tabular and graphic depictions of specific conductance, total hardness, total dissolved solid, dissolved oxygen, temperature, chlorides, sulfates, sodium-potassium and volume are given. Thermocline formation occurred during March and remained until late September or early October each year. Lake volume increase was spasmodic with major inflows in 1965 and 1967. The volume (300,000 acre-feet), as of December 31, 1968, represents less than half the total capacity of the reservoir. Sodium-potassium, chlorides, and sulfates showed steady increases from less than 100 mg/liter to near 250 mg/liter during the 4-year period. Increases in total hardness, total dissolved solids, and specific conductance are given. Increase in mineral constitutents appeared to be from leaching and solution of geological formations in the lake bed and walls.

15458. Smith, L. S., J. B. Saddler, R. C. Cardwell, A. J. Mearns, and H. M. Miles (Fish. Res. Inst., Washington Univ., Seattle, Washington). 1971. RESPONSES OF TELEOST FISH TO ENVIRONMENTAL STRESS. Environ. Protection Agency, Water Pollution Control Res. Series, February 1971, 114 p.; Selected Water Resources Abstracts, 5(14): p. 52.

A floating laboratory was built for conducting multiparameter physiological studies on salmon in marine, estuarine and fresh water. New methods were developed using a swimming chamber-respirometer for adult salmon. Normal values were measured for a variety of physiological functions, then repeated on salmon migrating through an urban estuary characterized by sewage pollution and low dissolved oxygen. Effects included decreased swimming stamina and respiratory efficiency, decreased oxygen consumption and increased lactate, decreased urine flow and ammonia excretion, especially in the presence of environmental ammonia. Longer term disruptions in hematology and lipid metabolism occurred. Most of the effects occurred at dissolved oxygen concentrations just below 5 mg/l, except for synergistic effects between ammonia and low dissolved oxygen at somewhat higher concentrations.

15459. Gift, J. J., and J. R. Westman (Dept. of Environ. Resources, Rutgers - The State Univ., New Brunswick, New Jersey). 1971. RESPONSES OF SOME ESTUARINE FISHES TO INCREASING THERMAL GRADIENTS. Privately published monograph, June 1971, 154 p.; Selected Water Resources Abstracts, 5(14): p. 52.

The projected enormous volumes of water needed by industry for cooling purposes, and the concomitant thermal loading, make it increasingly important to characterize the thermal requirements of fishes. An experimental apparatus was designed to produce a moving thermal gradient of 2-3 F over an 18 ft long tank. It was used to determine the upper avoidance temperatures and upper avoidance breakdown temperatures of some important estuarine fishes and invertebrates. These included the winter flounder (Pseudopluronectes americanus), the northern puffer (Sphaeroides maculatus), the silver perch (Bairdiella chrysura), the bluefish (Pomatomus saltatrix), the northern kingfish (Menticirrhus saxatilis), the Atlantic silversides (Menidia menidia), the striped bass (Morone saxatilis), the white perch (Morone americana), the striped killifish (Fundulus majalis), the mummichog (Fundulus heteroclitis), the sheepshead minnow (Cyprinodon variegatus), the spotted seahorse (Hippocampus erectus), the pinfish (Lagodon rhomboides), the crevalle jack (Caranx hippos), the grass shrimp (Palaemonetes vulgaris), and the blue crab (Callinectes sapidus). Responses to thermal stimuli were affected by the past thermal history and the size of the organisms and by the season of the year.

15460. Pederson, G. L. (Army Environ. Hygiene Agency, Edgewood Arsenal, Maryland). 1970. EVALUATION OF TOXICITY OF SELECTED TNT WASTES ON FISH, PHASE I - ACUTE TOXICITY OF ALPHA-TNT TO BLUEGILLS, 1 JANUARY 1970 - 31 OCTOBER 1970. Sanitary Engineering Special Study No. 24-007-70/71, 35 p., available from the NTIS as AD-725 572, $3.00 paper, $0.95 microfiche; Selected Water Resources Abstracts, 5(14): p. 56.

The acute toxicity of alpha-TNT (2, 4, 6 trinitrotoluene) to bluegills was determined relative to variations in water temperature or in water hardness. Ninety-six hour LC-50 values ranged from 2.3 to 2.8 mg/l of alpha-TNT. Water temperature significantly affected the toxicity of alpha-TNT, i.e. lower concentrations were required to ellicit toxicity at 10C than at 25C. Water hardness had no apparent effect.

15461. Alton, Miles S., and Christine J. Blackburn. 1972. DIEL CHANGES IN THE VERTICAL DISTRIBUTION OF THE EUPHAUSIIDS, Thysanoessa spinifera Holmes AND Euphausia pacifica Hansen, IN COASTAL WATERS OF WASHINGTON. Calif. Fish and Game, 58(3): 179-190.

Time-depth related variations in Isaacs-Kidd trawl catches of the euphausiid, Thysanoessa spinifera, in contenental shelf waters of Washington during the summer of 1967 suggest that this species performs diel vertical movements. During the hours of 0800 to 1500 moderate size catches of T. spinifera were obtained from deep water (35 to 53 fathoms), but mid-depth (20 - 27 fathoms) and near surface tows (7 - 10 fathoms) during this period yielded negligible numbers of euphausiids. After 1500 hours catch rates from deep water increased markedly, but by evening the availability of T. spinifera had shifted from deep water to mid- and near-surface depths. High catch rates were sustained from near-surface waters throughout the late evening and early morning hours (2200 to 0500 hours). A similar pattern of availability with time and depth was found for the euphausiid, Euphausia pacifica.

15462. Castle, William T., and Leon A. Woods, Jr. 1972. DDT RESIDUES IN WHITE CROAKERS. Calif. Fish and Game, 58(3): 198-203.

The level of DDT residues in white croaker (Genyonemus lineatus) flesh (group A) and flesh with the skin left on (group B) was determined by gas liquid chromatography. The percent fat in group A and group B also was determined. There are significant differences ($P < .01$) between levels of DDT and between the percent fat in the two groups. The fat determined for group A was 3.76% (SE = 0.37%) and for group B for 6.06% (SE = 0.48%). The total DDT residue (including pp'DDT, its metabolites and isomers) for group A was 10.82 ppm (SE = 0.96 ppm) and for group B was 18.23 ppm (SE = 1.95 ppm). The only residues detected at the limit of detection of 0.01 ppm were 1, 1-dichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethylene, (op'DDE; 1, 1, 1-trichloro-2-(o-chlorophenyl)-2-(p-chlorophenyl) ethane, (op'DDT); 1, 1-dichloro-2, 2-bis (p-chlorophenyl) ethane, pp'DDD); and 1, 1, 1-trichloro-2, 2-bis(p-chlorophenyl) ethane, (pp'DDT). Many of the samples analyzed exceeded U. S. Food and Drug Administration guideline tolerance of 5.0 ppm wet weight for total DDT.

15463. Kesner, William D., and Roger A. Barnhart. 1972. CHARACTERISTICS OF THE FALL-RUN STEELHEAD TROUT (Salmo gairdneri gairdneri) OF THE KLAMATH RIVER SYSTEM WITH EMPHASIS ON THE HALF-POUNDER. Calif. Fish and Game, 58(3): 204-220.

Creel census data for the 1958, 1962, 1967, and 1968 Klamath River runs were analyzed to determine growth, age composition, sex ratios, maturity, migrations, food feeding habits, and length-weight relationship of fall-run steelhead, particularly half-pounders, (defined here as steelhead 250-349 mm FL). These were in the 1/1, 2/1, 3/1 age categories and were on their first upstream migration after only a few months in the ocean. Most half-pounders are immature, but probably return as mature steelhead after a second season in the ocean. Half-pounders, in contrast to mature steelhead, feed extensively on their first upstream migration. The sex ratio of all Klamath River fall-run steelhead is about 1:1. Condition factors increase in saltwater and decrease in fresh. Scale formation begins at about 30 mm.

15464. Rawstron, Robert A., and Kenneth A. Hashagen, Jr. 1972. MORTALITY AND SURVIVAL RATES OF TAGGED LARGEMOUTH BASS (Micropterus salmoides) AT MERLE COLLINS RESERVOIR. Calif. Fish and Game, 58(3): 221-230.

A tagging study from 1965 through 1969 revealed that exploitation rates of largemouth bass increased after the first season following impoundment, reaching a high of 0.65 in 1968 and 1970. Annual survival rates generally increased and stabilized near 0.20. Natural mortality declined. A combination of the highest reported exploitation rates, reduced annual catches, lowered catch/hour, increased bluegill populations, and competition with smallmouth bass and threadfin shad indicate possible continued depletion and overexploitation of largemouth bass.

15465. Elliot, George V., and T. M. Jenkins, Jr. 1972. WINTER FOOD OF TROUT IN THREE HIGH ELEVATION SIERRA NEVADA LAKES. Calif. Fish and Game, 58(3): 231-237.

A year-round analysis of trout stomach contents from three high elevation Sierra Nevada lakes showed that brook trout (Salvelinus fontinalis) and rainbow trout (Salmo gairdneri) fed on a variety of aquatic prey throughout the winter. However, under-ice feeding was poor relative to summer feeding even when the loss of surface forms is accounted for. Since fish were active and readily caught with bait at temperatures of 1 C, we believe that poor feeding was due to reduced availability of important aquatic prey species rather than to a change in trout activity or readiness to feed.

15466. Varoujean, Daniel H. 1972. THE REOCCURRENCE OF THE CALIFORNIA SCORPIONFISH, Scorpaena guttata Girard, IN MONTEREY BAY. Calif. Fish and Game, 58(3): 238-239.

A specimen collected October 19, 1970 represents a reoccurrence of the species after 116 years.

15467. Haaker, Peter L. 1972. FIRST RECORD OF A REVERSED BUTTER SOLE, Isopsetta isolepis. Calif. Fish and Game, 58(3): 244-245.

A specimen was trawled off the Klamath River on November 4, 1971. The specimen was a male, 178 mm SL.

15468. Fitch, John E. 1972. A CASE FOR STRIPED MULLET, Mugil cephalus, SPAWNING AT SEA. Calif. Fish and Game, 58(3): 246-248.

A specimen taken 40 miles southwest of Cape Colnett, Baja, California late September, 1971 contained fully developed eggs. An examination of the enlarged ovaries revealed numerous loose eggs in the lumen. The fish was brailed aboard a purse seiner fishing for bluefin tuna.

15469. Fitch, John E. 1972. THE COTTONMOUTH JACK, Uraspis secunda, ADDED TO THE MARINE FAUNA OF CALIFORNIA. Calif. Fish and Game, 58(3): 245-246.

A specimen 323 mm SL was caught off the offshore side of Catalina Island in September, 1971.

15470. Grover, Charles A. 1972. POPULATION DIFFERENCES IN THE SWELL SHARK Cephaloscyllium ventriosum. Calif. Fish and Game, 58(3): 191-197.

Emigration of swell sharks between Santa Catalina Island and the nearby California mainland is prevented or severely restricted by the intervening deep basin. Reproductive isolation is shown by an extreme difference in egg-case tendril length between the two populations. Supporting evidence is found in differences in egg-case size and relative fin size. Two egg-cases from Isla Guadalupe, Mexico, have the same tendril-less configuration as those from Santa Catalina Island, suggesting that this is an insular character.

15471. U. S. Department of the Interior (Washington, D. C.). 1972. 1970 NATIONAL SURVEY OF FISHING AND HUNTING. U. S. Dept. of the Interior, Bureau of Sport Fisheries and Wildlife Resource Publication 95, 108 p., illus. For sale by the Supt. of Documents, U. S. Govt. Printing Office, Wash., D. C., $1.25.

15472. Hurlbert, Stuart H., Mir S. Mulla, and Harold R. Willson (Dept. of Entomol., Univ. of Calif., Riverside, California). 1972. EFFECTS OF AN ORGANOPHOSPHORUS INSECTICIDE ON THE PHYTOPLANKTON, ZOOPLANKTON, AND INSECT POPULATIONS OF FRESH-WATER PONDS. Ecological Monographs, 42(3): 269-299.

Dursban, an organophosphorus insecticide, was applied on June 3, June 18, and July 1 to eight shallow (24 cm) experimental ponds near Bakersfield, California. Four ponds were treated at 0.028 kg/ha (= 0.025 lb./acre), four were treated at 0.28 kg/ha, and four were kept as controls. Phytoplankton, zooplankton, and insect populations were sampled on 21 dates between May 20 and August 16. Insect larvae and nymphs were more reduced in numbers than were insect adults, reflecting in part the ability of the latter to emigrate and immigrate. Twenty-four-hour posttreatment samples for the second and third, but not first, treatments showed greater reductions of predaceous (Notonectidae, Dytiscidae, Coenagrionidae, larval Hydrophilidae) than of "herbivorous" (Corixidae, Baetidae, adult Hydrophilidae) insect populations. Predaceous insect populations generally recovered to control-pond levels more slowly than herbivorous insect populations. Five weeks after the last insecticide treatment, predaceous insects averaged only 45% and 9% as abundant in low dose and high dose ponds, respectively, as they were in control ponds (P 0.02); corresponding figures for herbivorous insects were 108% and 206% (P 0.10). Initially, Cyclops vernalis and Moina micrura were the only crustacean zooplankters present, and both experienced high mortality due to treatments. Recovery in low dose ponds was variable, requiring 1-3 weeks, and in high dose ponds occurred only 3-6 weeks after the final treatment. Populations of Diaptomus pallidus seemed unaffected by the lower rate of treatment, but became large only after Cyclops populations had been reduced by the insecticide or other factors. Ceriodaphnia sp. became abundant in late July or early August in all four control ponds but not in any treated ponds. Herbivorous rotifers, principally in the genera Brachionus, Polyarthra, Hexarthra, Filinia, and Tripleuchlanis, increased dramatically, often five- to twentyfold, within 1-3 days after Moina and Cyclops populations were decimated by Dursban, but became abundant in control ponds only during the brief absence of Moina in early July. All planktonic rotifers, except Polyarthra, were more abundant in treated than in control ponds; all benthic-littoral rotifers (e.g., Lecane, Monostyle, Tripleuchlanis, Platyias, Lepadella, Testudinella) were more abundant in control than in treated ponds. The predaceous rotifer Asplanchna brightwelli was 35 times more abundant in treated than in control ponds, feeding primarily on herbivorous rotifers, sometimes on Cyclops, Diaptomus, Moina, and large algae, and rarely on small mayfly (Baetidae) nymphs and chironomid larvae. Asplanchna populations were composed of three morphotypes, ampulliform, cruciform, and campanuliform, the last of which tended to be highly cannibalistic. The "wings" of humps of the cruciform morphotype apparently represent a mechanism for minimizing such cannibalism. The reduction of herbivorous crustaceans by Dursban and the restraint of herbivorous rotifers by Asplanchna predation permitted the rapid increase of phytoplankton populations in treated ponds and, even 6 weeks after the last treatment, the phytoplankton was two and sixteen times more abundant in low dose and high dose ponds, respectively, than in control ponds. Blooms of bluegreen algae (Anabaena, Anabaenopsis) developed in three high dose and one low dose pond, and a bloom of the diatom Synedra developed in one low dose pond. The long-spined alga Schroederia setigera seemed favored by high Moina and Diaptomus populations and low Cyclops populations. The significance of these results for insect-control programs is discussed. (Authors)

15473. Hagen, D. W., G. E. E. Moodie, and P. F. Moodie (College of Fisheries, Univ. of Wash., Seattle, Washington). 1972. TERRITORIALITY AND COURTSHIP IN THE OLYMPIC MUDMINNOW (Novumbra hubbsi). Canad. J. Zool., 50(8): 1111-1115.

Male Novumbra hubbsi are highly aggressive during reproduction when they hold very large territories over long periods of time. A description of aggressive displays, territoriality, and courtship is given from a sample of 29 males in the laboratory and 26 in the field, and the striking convergence in black colors of breeding male sticklebacks and Novumbra where they coexist is considered. (Authors)

15474. Pearson, William D., and Robert H. Kramer (Dept. of Biol. Sci., North Texas State Univ., Denton, Texas). 1972. DRIFT AND PRODUCTION OF TWO AQUATIC INSECTS IN A MOUNTAIN STREAM. Ecological Monographs, 42(3): 365-385.

The relationships between drift rates, population density, production rates, key environmental factors, and movements of adults were studied in two populations of stream insects, the caddisfly Oligophlebodes sigma and the mayfly Baetis bicaudatus. Samples of benthic invertebrates (424 total) were collected every 28 days at four stations on Temple Fork of the Logan River, Utah, from October 1967 to September 1969. Samples of drift invertebrates (181 total) were collected every 14 days at three stations on Temple Fork during the same period. During June-September a day and a night drift sample (681 total) were collected every other day. Drift rates of O. sigma larvae were greatest (5,987 g/year) when biomass in the benthos (2.56 g/m^2) and production (4.30 g/m^2 per year) were greatest. Total production (dry weight) of O. sigma larvae in the stream (bottom area = 29,487 m^2) was 89.0 kg in 1968 and 80.8 kg in 1969. Total production of B. bicaudatus nymphs was 41.3 kg in 1968 and 39.8 kg in 1969. Drift rates of O. sigma larvae were related directly to biomass in the benthos over an entire year. Drift rates of O. sigma and B. bicaudatus were not related directly to density expressed as numbers/area in the benthos. Drift rates were correlated positively and significantly (r = 0.78 and 0.55 for day drift of O. sigma and B. bicaudatus, respectively) with density during the months of June-September for both O. sigma larvae and B. bicaudatus nymphs. Discharge, distance below the spring source of Temple Fork, and densities of competing aquatic insects were other factors of significance in the multiple-regression analyses of factors affecting drift rates of the two insects. The 17 or 18 independent variables used in the multiple-regression analyses accounted for 65% and 55% of the variability in day drift rates of O. sigma and B. bicaudatus, respectively. Adult O. sigma (but not B. bicaudatus) undertook a definite upstream migration estimated at 2-3 km. This flight of adults resulted in a concentrated deposition of eggs in the upper reaches of the stream. The advantage of the upstream flight may be that it stores reproductive products in areas where they are relatively safe from effects of anchor ice during winter and of floods in late winter and early spring. (Authors)

15475. Jacquest, W. L., and D. D. Beatty (Dept. of Zool., Univ. of Alberta, Edmonton, Alberta, Canada). 1972. VISUAL PIGMENT CHANGES IN THE RAINBOW TROUT, Salmo gairdneri. Canad. J. Zool., 50(8): 1117-1126.

The retinae of rainbow trout, Salmo gairdneri, have mixtures of two visual pigments, one based on retinaldehyde ($VP503_1$), the other on 3-dehydroretinaldehyde ($VP527_2$). Increases in the proportion of $VP527_2$ or maintained high percentages of $VP527_2$ were induced in three ways: (1) feeding a diet rich in 3-dehydroretinol; (2) intraperitoneal injections of L-thyroxine; and (3) intramuscular injection of bovine thyrotropic hormone. The possible significance of these findings in relation to carotenoid conversions in fish is discussed. (Authors)

15476. Bertmar, Gunnar (Dept. of Biol., Section of Ecol. Zool., Univ. of Umea, Umea, Sweden). 1972. ECOSTRUCTURAL STUDIES ON OLFACTORY ORGAN IN YOUNG AND ADULT SEA TROUT (OSTEICHTHYES, SALMONIDAE). Zeitschrift für Morphologie der Tiere, 72(4): 307-330.

The development of cells of the olfactory organ in young (parr and smolt) and adult Baltic sea trout is investigated from an ecological point of view. A theory on cell dynamics is presented. Blastema cells are basal cells which divide into goblet cells, primary receptors and primary supporting cells. The latter cell type remains one of undifferentiated fibroblasts. In the indifferent epithelium the primary supporting cells then differentiate into ciliated nonsensory cells, whereas in the sensory epithelium they form ciliated and nonciliated supporting cells. The primary receptors develop into spindle receptors, and these into rod receptors. This dimorphism of supporting cells and receptors and the grouping of them is discussed. Indications on aging of the epithelium are presented. The epithelial cells are arranged in zones. Mainly in the basal zone there is a supply of lymphoid wandering cells and macrophages some of which move into other zones and

phagocytize dead or degenerating cells. Dead cells are also extruded into the olfactory chamber. This occurs especially during the initial secondary folding of the primary olfactory laminae. Different aspects on ecological adaptation of cells and structures are presented. Baltic sea trout have a dynamic cell population and secretion adapted for life both in river and sea. (Auth.)

15477. Timm, T. 1962. THE OLIGOCHAETE WORMS OF CHUD-PSKOV LAKE. (Maloshchetinkovye chervi Chudsko-Pskovskogo Ozera). Gidrobiologicheskie issledovaniya III, Institut Zoologii i Botaniki Akademii Nauk Estonskoĭ SSR, 106-108. Translated by Robert M. Howland, 1971.

Twenty-nine species of oligochaetes were found in Chud-Pskov Lake: added to the 20 species known to be in the body of water were: Chaetogaster diaphanus, Nais variabilis, Slavina appendiculata, Rhyacodrilus coccineus, Euilyodrilus moldaviensis, Tubifex tubifex, I. smirnovi, Lumbriculus variegatus and Eiseniella tetraedra. The average population density of oligochaetes in the lake ranged between 370-1400 specimens/m^2.

15478. Timm, T. 1962. ON THE POSSIBILITY OF PROPAGATION OF TUBIFICIDS. (O Vozmozhnosti Razvedeniya Tubifitsid). Gidrobiologicheskie issledovaniya III, Institut Zoologii i Botaniki Akademii Nauk Estonskoĭ SSR, 162-168. Translated by Robert M. Howland, 1971.

Four mass species of tubificids are reared as monocultures: Euilyodrilus hammoniensis, Tubifex tubifex, Limnodrilus hoffmeisteri and L. udekemianus. The reproduction of T. tubifex is accelerated by increase in temperature. In the laboratory it reaches sexual maturity in 2-4 months; after similar intervals it produces new broods continuously (normally there are 14-44 individuals in each, often 30-35). Its longevity is no less than two years. The normal rate of reproduction is maintained only with the condition of periodic removal of the young; fecundity decreases sharply according to the increase in population density.

15479. Kennedy, Michael, and Patrick Fitzmaurice (Inland Fisheries Trust, Dublin, Ireland). 1972. THE BIOLOGY OF THE BASS, Dicentrarchus labrax, IN IRISH WATERS. J. Mar. biol. Assn. U.K., 52(3): 557-597.

Bass, Dicentrarchus labrax (L.), have been caught on most parts of the Irish coast but are most abundant in the south and south-west. They are scarce or rare on part of the northeast coast and have only occasionally been caught on the northwest coast. On the Irish coast bass frequent beaches and estuaries and they also shoal in bays and over reefs to attack small baitfishes at the surface. There is a winter offshore movement on most parts of the coast, except in the south-west. Of 895 adult bass tagged during the years 1967-70, 25 had been recaptured by the end of October 1971. These 25 bass had been at liberty for periods of 0-364 days and were taken at distances of 0-42 miles from where they were tagged. The distances they travelled were not in proportion to the intervals between tagging and recapture. Female bass mature at a minimum fork length of 35.5 cm, mostly when 5-8 years old; the males mature at a minimum fork length of about 31.5 cm, mostly when 4-7 years old. Irish bass are probably fractional spawners. The females, once mature, spawn every year. May is probably the chief spawning month on the Irish coast. Five known spawning areas (where eggs have been obtained) include three situations near river mouths and two areas of shoal water and swift tides on the open coast. The juvenile bass are found mainly in estuaries, creeks, pills and lagoons. There is considerable variation in the strength of year-classes; in 1967 and 1968 nearly half the stocks of adult bass on the Irish coast were fish which had been spawned in 1959. Juvenile bass feed on small crustaceans and worms and sometimes on small fish. The main foods of the adults are herring fry, sprats, sand eels, shore crabs, sand shrimps and young flatfishes. Irish bass are long-lived and relatively slow-growing and fish of up to 24 years old were examined. The males grow more slowly than the females and tend to be of shorter life. Bass grow more rapidly in warm than in cool summers, and the adult bass at present being caught are smaller than bass of corresponding ages caught during the period of 1947-63. (Authors)

15480. Wardle, C. S. (Mar. Lab., Aberdeen, Scotland). 1972. THE CHANGES IN BLOOD GLUCOSE IN Pleuronectes platessa FOLLOWING CAPTURE FROM THE WILD: A STRESS REACTION. J. Mar. biol. Assn. U.K., 52(3): 635-651.

In Pleuronectes platessa blood-glucose levels rise following capture from a range of 15-25 mg/100 ml to elevated levels between 25 mg and 120 mg 8 h post capture. After 2-3 days the glucose levels return to 15-25 mg and the fish is then insensitive to further attempts to elevate glucose. Only slight elevation of blood glucose could be obtained from simulated trawl capture of the tank-adapted plaice with low blood glucose. Adrenaline was effective only when injected into the muscle and the evidence suggests that the glucose might be released from the muscle glycogen in the area of the injection. The experiments were made using serial samples from individuals and injecting directly to their blood stream. Alloxan injected at near lethal doses caused substantial elevation of blood glucose in the adapted fish. However, evidence against high insulin levels in the adapted fish included: (a) an improved response to a repeated glucose load and (b) an improved response to a single glucose load following pretreatment with insulin. Insulin (1 i. u. /kg) was effective in reducing the high blood glucose post capture to low adapted levels. The space in which glucose is diluted following injection to the blood was estimated as 29.4 $\pm$ 3.4% of the body weight and this space was significantly depleted of glucose by insulin injection. The non-reactivity of blood glucose levels of the tank-held fish is discussed. (Auth.)

15481. Sykora, J. L., E. J. Smith, and M. Synak (Grad. School of Public Health, Univ. of Pittsburgh, Pittsburgh, Pennsylvania). 1972. EFFECT OF LIME NEUTRALIZED IRON HYDROXIDE SUSPENSIONS ON JUVENILE BROOK TROUT (Salvelinus fontinalis, Mitchill). Water Research, 6(8): 935-950.

The experimental dosing apparatus was a modified proportional diluter equipped with a neutralization device and with a series of detention and oxygenation tanks. Ferric hydroxide was obtained by neutralization of ferrous sulfate using calcium hydroxide. After neutralization, oxygenation, and detention, suspended iron was released automatically at regular intervals into the test aquaria. Four concentrations of iron were maintained, each containing 10 young brook trout (3 months old). The data on length of brook trout revealed a definite trend toward smaller size with increasing concentration of suspended ferric hydroxide, with the largest trout in 6 mg Fe l^{-1} and in the control. The average weight of brook trout was much lower in high iron concentrations than in the control and 6 mg Fe l^{-1}. The final mean weight of fish in 50 mg Fe l^{-1} represented only 16 percent of the control, with gradually increasing percentage proportions occurring in lower iron concentrations. The final mean weights of the fish in 6 mg Fe l^{-1} and in the control were almost identical. The average growth rate computed for five different size groups of fish revealed a sudden decline in growth of brook trout exposed to 12, 25, and 50 mg Fe l^{-1}. The growth rate of brook trout in 6 mg Fe l^{-1} and in the control shows only a leveling trend as of the thirty-fifth week. It is assumed that impaired visibility due to high turbidity prevented the fish from feeding which in turn resulted in slow growth in high iron concentrations - 12, 25 and 50 mg Fe l^{-1}. ((Authors)

15482. Ryzhova, L. N., and P. Ya. Tugarina (Dept. of Vertebrate Zool., Irkutsk State Univ. and Baikal Biol. Sta., USSR). SOME BLOOD CHARACTERISTICS OF THE BAIKAL BLACK GRAYLING [Thymallus arcticus baicalensis (Dyb.)] WITH REFERENCE TO THE ASSESSMENT OF CONDITIONS FOR ITS REARING. Journal of Ichthyology, 11(5): 781-790.

Some of the blood characteristics of the black grayling have been investigated in relation to the conditions of rearing on different foods to an age of 4 years. The blood of the grayling was influenced by the diet (under defined temperature and oxygen regimes and in a fixed space) by modification of its composition. The hematological characteristics obtained lead the authors to recommend that the food used in the rearing of young black grayling to viable stages should be rotifers, Epischura, some Daphnia species (up to a certain age), Oligochaeta, gammarids and yellowfin Baikal sculpin larvae.

15483. Lyakhnovich, V. P., and Ye. N. Leonenko (Byelorussian Fisheries Res. Inst., USSR). 1971. AGE-RELATED CHANGES IN SOME OF THE CHARACTERISTICS OF THE BLOOD OF THE SILVER CARP [Hypophthalmichthys molitrix (Val.)], THE GRASS CARP [Ctenopharyngodon idella (Val.)] AND THE POND CARP [Cyprinus carpio (L.)]. Journal of Ichthyology, 11(5): 743-750.

Age-related and seasonal variations have been discovered in the volume of blood, hemoglobin concentration in the blood and total hemoglobin content in the silver carp [Hypophthalmichthys molitrix (Val.)], the grass carp [Ctenopharyngodon idella (Val.)] and the pond carp [Cyprinus carpio (L.)]. Data are given on the morphology of the blood of these fishes, measurements of the quantity of erythrocytes and erythropoiesis in the peripheral blood.

15484. Maksimova, Ye. M., O. Yu. Orlov, and A. M. Dimmentman (Inst. of Problems of Information Transmission, USSR Acad. of Sci. and Biol. and Soil Faculty, Moscow State Univ., Moscow, USSR). 1971. A STUDY OF THE OPTIC SYSTEM OF SOME SPECIES OF MARINE FISHES. Journal of Ichthyology, 11(5): 773-780.

Endings of optic fibers of four types were found in a microelectrode study of the optic tectum of the mesencephalon in fishes. The endings of different types lie at different depths from the surface. The endings of fibers which are sensitive to the direction of movement of a stimulus lie nearer the surface. The elements which yield the maximum response to the movement of a small dark spot in any direction lie deeper. These are followed by elements of the opponent type which discriminate colors. The responses of elements with spontaneous activity (a lasting pulse discharge) are recorded deepest of all. The receptive fields of the elements are 2-10 angular degrees. No physiological differences related to the ecology or systematic position of the species of fishes investigated were discovered.

15485. Afanas'yev, V. I., and L. I. Kolot (Krasnodar Branch, All-Union Pond Fisheries Res. Inst. (KRASNIIRKh), USSR). 1971. ALTERATION OF PEROXIDASE AND CYTOCHROME OXIDASE IN THE BLOOD OF CARP [Cyprinus carpio (L.)] SUFFERING FROM RED-SPOT DISEASE. Journal of Ichthyology, 11(5): 822-825.

Carp blood contains redox enzymes, namely peroxidase and cytochrome oxidase; an increase of peroxidase content and a reduction of cytochrome oxidase content in fish suffering from red-spot disease indicates that the course of redox processes in fish tissues is affected in this disease.

15486. Panyushkin, Yu. A. (Astrakhan Fisheries and Fish Industry Technical Inst., USSR). 1971. THE EFFECT OF THE SALINITY OF WATER ON THE STATE OF ANTIOXIDATION SYSTEMS IN THE TISSUES OF NONANADROMOUS FISHES. Journal of Ichthyology, 11(5): 826-830.

Alteration of osmotic conditions leads to disturbance to the integrity of the organism in fishes. This is reflected both at the molecular and at the physiological level. The osmotic factor, which causes a response reaction in the tissues of fishes also has characteristic specific features for freshwater and marine fishes in the nature of the alteration of the AOA (antioxidation activity) in the liver. In marine fishes there is expenditure of antioxidants in this organ, whereas in freshwater fishes the AOA is increased when salinity is altered. A different amount of energy is expended in the various types of osmotic regulation in different species of fishes and there is probably a different alteration in the level of oxidation processes when the salinity of the water changes. Stenohaline fishes do not apparently have a sufficient reserve of antioxidants. When they are exposed to increased salinity the rate of oxidation and the expenditure of antioxidants in the gills and blood of the fishes are intensified. Reduction of the quantity of antioxidants in the gills below a certain level probably shows that intensifying oxidation processes lead to profound changes in the functioning organ and that these changes are ultimately accompanied by the death of the fish.

15487. Leggett, William C., and Richard R. Whitney (Essex Marine Lab., Essex, Connecticut). 1972. WATER TEMPERATURE AND THE MIGRATIONS OF AMERICAN SHAD. NOAA Fishery Bull., 70(3): 659-670.

The peak of spawning runs of American shad (Alosa sapidissima) into rivers at various latitudes on the Atlantic and Pacific coasts of North America takes place when water temperatures are near 18.5°C. At the Bonneville Dam, Columbia River, Wash., 90% of the run as a rule takes place when river temperatures are between 16.0° and 19.5°C. At the fish ladder of the Holyoke Water Power Company on the Connecticut River, the temperature at the peak of the shad run averaged 19.5°C for 15 years. In the St. Johns River, Fla., peak movement occurs in December and January at the time of the annual minimum water temperatures, or 14.0° to 20.0°C. Migrations of shad in the Atlantic Ocean follow paths associated with approximately the same range of temperatures (13.0°-18.0°C). Annual cycles of ocean warming cause shad to move into the Gulf of Maine in the summer, to the middle Atlantic in the winter, and to the south in the early spring. Juvenile shad move downstream in the fall, coinciding with a decline in the temperature of each stream to below 15.5°C. A path of migration for shad in the Pacific Ocean is hypothesized from the known seasonal changes in ocean temperature. The potential effects of artificial warming of streams on timing and survival of shad runs in northern and southern latitudes is discussed. (Authors)

15488. Rothschild, Brian J. (NMFS, Northwest Fisheries Center, 2725 Montlake Blvd. East, Seattle, Wash. 98112). 1972. AN EXPOSITION ON THE DEFINITION OF FISHING EFFORT. NOAA Fishery Bull., 70(3): 671-679.

The term "fishing effort" is well defined in population dynamics literature. The term as defined in the population dynamics literature is, however, difficult to reconcile with broader definitions of fishing effort, particularly those having economic implications. The present paper discusses the distinction between the definitions and gives some examples in the context of allocating inputs, the capacities of fishing boats, and several stocks to the catch in a manner which maximizes profits. Managerial behavior is also an important input to the fishing process; this is discussed in a decision theory format where decision quality can be measured relative to entropy in the decision environment affording a comparison among decision environments in terms of information and an imputed valuation of a bit of information under various circumstances. The conventional measures of the quality of the decision environment are often based upon expected catch. Alternate measures are discussed which include the expected loss or the risk involved in the decision process. (Auth.)

15489. June, Fred C. (Bur. Sport Fish. & Wildl., North Central Reservoir Investigations, P. O. Box 698, Pierre, South Dakota 57501). 1972. VARIATIONS IN SIZE AND LENGTH COMPOSITION OF ATLANTIC MENHADEN GROUPINGS. NOAA Fishery Bull., 70(3): 699-713.

This paper gives estimates of size (weight) and length composition of summer schools and fall school-aggregations of Atlantic menhaden based on single-set purse seine catches and accompanying catch samples obtained in 1955-62. The data show that the fish school by length and the average size of summer schools decreases as the apparent abundance of fish in a given area of the coast decreases. The significance of the school concept in the study of the dynamics of the population and the effects of fishing upon it are discussed, and additional avenues of research are suggested. (Auth.)

15490. Hobson, Edmund S. (Southwest Fisheries Center, P. O. Box 271, La Jolla, California 92037). 1972. ACTIVITY OF HAWAIIAN REEF FISHES DURING THE EVENING AND MORNING TRANSITIONS BETWEEN DAYLIGHT AND DARKNESS. NOAA Fishery Bull., 70(3): 715-740.

Activity during the morning and evening transitions between day and night was studied as part of a broad investigation of ecological relations among reef fishes in Kona, Hawaii, during 1969 and 1970. Most of the fishes are either diurnal or nocturnal, the former being mainly inactive at night, the latter mainly inactive in daylight. During active periods their behavior is dominated by feeding, whereas

inactive periods are dominated by measures to enhance security. Thus twilight behavior involves primarily a changeover from feeding to sheltering, and the reverse. Migrations of various types between shelter locations, where they rest, and feeding grounds are a major element of the transition periods. The transition events proceed in an established, well-defined sequence. In the evening, after the diurnal fishes have descended to shelter and before the nocturnal fishes have risen into the water column, there is an interim period of about 20 min during which both diurnal and nocturnal fishes are close to the substrate; it is at this time that reef fishes are most vulnerable to predators, and the proximity of cover offers protection. Similar behavior occurs among related fishes in the Gulf of California. The interim period in Kona corresponds in time relative to sunrise and sunset to the period during which schooling fishes in the Gulf of California are under heaviest attack; however, because schooling fishes and the predators that exploit them are not major elements of the Kona fauna, overt predator-prey interactions are not prominent there. Thus the well-ordered pattern of events that characterizes twilight in Kona also occurs on other reefs widespread in tropical seas, whether or not there exists in each of these areas today a severe threat from large piscivorous predators. The twilight pattern of actions is the result of a long evolution that in any one area transcends the existing situation and species. Because predator-prey interactions among fishes have been influenced throughout time by certain basic and unchanging phenomena, the similarity of twilight activity patterns among fishes on widely separated reefs today reflects the impact of a historic threat from predators. (Auth.)

15491. Murphy, Garth I., and Robert I. Clutter (Dept. of Oceanography, Univ. of Hawaii, Honolulu, Hawaii 96822). 1972. SAMPLING ANCHOVY LARVAE WITH A PLANKTON PURSE SEINE. NOAA Fishery Bull., 70(3): 789-798.

A miniature purse seine (100 ft by 21 ft) was constructed of 333 μ Nitex. It was used in Kaneohe Bay, Hawaii, together with a 1-m plankton net constructed of the same material in order to evaluate the sampling efficiency of the towed plankton net on anchovy larvae (Stolephorus purpureus). The results show that during the day, the purse seine is at least an order of magnitude more efficient for larvae over 5.5 mm in length. The largest larva caught by the plankton net was 14.5 mm and by the purse seine 29.5 mm. At night the plankton net was relatively more effective than during the day, catching about 60% as many larvae as the purse seine over the interval 3.5-19.5 mm. The maximum size taken increased to 21.5 mm, but the maximum taken by the purse seine increased to 50 mm. An attempt was made to rationalize the difference between the day plankton net and purse seine catches by a geometric model involving alarm distance and larval swimming speed. The results are moderately satisfactory. More limited data on anchovy larvae catches by a 10-ft Isaacs-Kidd trawl, 1/4-m, 1/2-m, and 1-m plankton nets are presented and discussed in the framework of the meter net-purse seine data. These analyses suggest one or more paradoxes in the larval escape problem, or that the data are inadequate. (Authors)

15492. Hunter, John R. (NMFS, Southwest Fisheries Center, P. O. Box 271, La Jolla, California 92037). 1972. SWIMMING AND FEEDING BEHAVIOR OF LARVAL ANCHOVY Engraulis mordax. NOAA Fishery Bull., 70(3): 821-838.

The swimming and feeding behavior of laboratory-reared larval anchovy, Engraulis mordax, was described over the first 30 days of larval life. Estimates were made of cruising speed, proportion of time spent in rest, and burst speeds. Tail beat frequency, tail beat amplitude, and speed of swimming larvae were measured from cine photographs and the relationship between these variables determined. Complete and incomplete feeding sequences were described in detail from cine photographs and expressed as a function of larval length. Feeding success of larvae fed rotifers was determined for the first 21 days of larval life. These estimates were combined to estimate the volume of water searched by larvae per hour, and this estimate and others were used to calculate the density of food required by larvae to meet metabolic requirements. These calculations indicated that the density of food required by larvae just after yolk absorption was up to 37 times that required by older larvae. (Auth.)

15493. Smith, Paul E. (NMFS, Southwest Fisheries Center, La Jolla, California 92037). 1972. THE INCREASE IN SPAWNING BIOMASS OF NORTHERN AN CHOVY, Engraulis mordax. NOAA Fishery Bull., 70(3): 849-874.

The northern anchovy, Engraulis mordax, is a common fish off the west coast of North America. Its biomass has increased markedly since 1951. The various methods of deriving anchovy spawner biomass from the sardine spawner biomass and analogous census estimates of sardine and anchovy larvae are reviewed. A new compilation of anchovy and sardine larval data is presented for 1940, 1941, 1949, 1950, and 1951-69. The effect of several errors of estimate are examined and it is concluded that none is important enough to affect measurably the trend of increase between 1951 and 1966. Lastly, a current interpretation of the larval survey data is used to estimate the spawning biomass of both sardine and anchovy. (Auth.)

15494. Lewis, U. J., R. N. P. Singh, B. D. Seavey, R. Lasker, and Grace E. Pickford (Div. of Endocrinology, Scripps Clinic and Research Foundation, La Jolla, California 92037). 1972. GROWTH HORMONE- AND PROLACTIN-LIKE PROTEINS OF THE BLUE SHARK (Prionace glauca). NOAA Fishery Bull., 70(3): 933-939.

The two major disc-electrophoretic components, designated as "slow" and "fast", which are seen in fresh homogenates of the pars distalis of the blue shark (Prionace glauca) pituitary gland were isolated. Some alteration of the proteins occurred during the purification as evidenced by appearance of a slightly faster migrating band in each. The slow component and its altered form had a molecular weight of 22,000 daltons; the fast, and its modified form, 20,000 daltons. The two proteins were very similar chemically and immunologically, but definite differences were noted. Both gave a precipitin line with antiserum to mouse growth hormone, although quantitatively different, but neither reacted to antiserum to mouse prolactin. The peptide maps of the two proteins were identical except for three peptides. Both contained two moles of tryptophan and six half-cystine residues. These results indicate that the pars distalis of the blue shark contains two very similar proteins that resemble both growth hormone and prolactin of mammals. (Authors)

15495. Moser, H. Geoffrey (NMFS, Southwest Fisheries Center, La Jolla, California 92037). 1972. DEVELOPMENT AND GEOGRAPHIC DISTRIBUTION OF THE ROCKFISH, Sebastes macdonaldi (Eigenmann and Beeson, 1893), FAMILY SCORPAENIDAE, OFF SOUTHERN CALIFORNIA AND BAJA CALIFORNIA. NOAA Fishery Bull., 70(3): 941-958.

The larval and juvenile stages of the scorpaenid fish, Sebastes macdonaldi, are described and illustrated. The sequence of ossification of bones and cranial spines in larvae is described in detail. S. macdonaldi appears to have the most southerly distribution of any species of Sebastes in the eastern north Pacific. The geographic distribution and seasonal abundance of S. macdonaldi larvae are discussed and compared with published information on the adults.

15496. Wolfe, D. A., and T. R. Rice (NMFS, Atlantic Estuarine Fisheries Center, Beaufort, North Carolina 28516). 1972. CYCLING OF ELEMENTS IN ESTUARIES. NOAA Fishery Bull., 70(3): 959-972.

Meaningful evaluation of the ecological stresses imposed by man's release of heavy metals or radioisotopes into estuaries requires an improved understanding of the interactions between the waste materials and the functional components of the ecosystem. In this paper, we review and discuss the types of information required for the development of useful models for the cycling of contaminant metals (both radioactive and stable) in estuarine ecosystems. With particular reference to the coastal plain estuaries of the southeastern United States, we discuss the major reservoirs of those metals, the mechanisms and pathways of elemental transformation and rates of elemental turnover among reservoirs, and the responses of these processes and reservoirs to environmental change. A conceptual systems model is presented as the preliminary phase in the development of dynamic mathematical models of elemental cycling. (Authors)

15497. O'Connell, Charles P., and James R. Zweifel (NOAA, NMFS, Southwest Fisheries Center, LaJolla, California 92037). 1972. A LABORATORY STUDY OF PARTICULATE AND FILTER FEEDING OF THE PACIFIC MACKEREL, Scomber japonicus. NOAA Fishery Bull., 70(3): 973-981.

In laboratory feeding trials Pacific mackerel, Scomber japonicus, averaging 147 g in weight did not respond to Artemia nauplii, but did capture Artemia adults by biting (particulate feeding) when density was 1 or 2/liter and by filtering when density was 22 to 112/liter. Particulate feeding is described by $N_p = 60.3tD$, where N is the number of Artemia ingested in t minutes at D numbers per liter. Filter feeding is described by $N_f = 23,788\ (1 - e^{-0.0036t\sqrt{D}})$, where 23,788 is an asymptotic estimate of the number of Artemia in the digestive tract at full capacity. The results suggest that the mackerel utilizes only the larger of the planktonic crustaceans, such as euphausiids, in the sea. For the relatively low average densities of such organisms the derived equations indicate that the mackerel could not obtain its daily nutritional requirement, estimated to be 8% of body weight, in less than 24 hr of feeding. Though the daily requirement could be obtained in much shorter periods, perhaps by filter feeding, if such crustaceans are encountered in aggregations of considerably higher density than reflected by area averages, it is probable that the mackerel must often depend in part on such larger organisms as fish to fulfill its needs. Comparison of the mackerel ingestion rates to those for the smaller northern anchovy indicates that while the individual mackerel may generally capture a greater proportion of the large crustaceans encountered than the anchovy, the proportion captured would have a relatively lower nutritional value for the mackerel. (Authors)

15498. Kimura, Makoto, and Gary T. Sakagawa (NMFS, Southwest Fisheries Center, La Jolla, California 92037). 1972. OBSERVATIONS ON SCALE PATTERNS AND GROWTH OF THE PACIFIC SARDINE REARED IN THE LABORATORY. NOAA Fishery Bull., 70(3): 1043-1052.

Scale patterns and growth of Pacific sardine (Sardinops caerulea) were studied with laboratory-reared fish held for 24 months. All scales examined after the fourth month had accessory marks. The first accessory mark was formed in August to October and the second accessory mark, in May to August. The accessory marks were indistinguishable from annuli that formed in November to March. Five possible causal factors of mark formation were investigated - temperature, salinity, gonad index, condition factor, and relative growth rate. Growth rate showed the best correlation. The accessory mark was formed during a period of change in growth rate and the annulus during a period of relatively constant growth rate. An estimate of the body length-scale radius relation indicated that scales first increase in size at a body length of 33 mm. Growth in length was rapid from the start of the experiment to the fourth month, after which the increase was gradual. The average instantaneous rate of growth was about 0.47/month during the first 4 months and about 0.03/month thereafter. It was concluded that the abrupt increase in L_1 that was recorded in the 1940's for the sardine population was probably caused by errors in aging, owing to a change in scale readers and scale-reading criteria. The ages of fish age II and older were probably underestimated by the recent scale readers. (Authors)

15499. Isaacs, John D. (Univ. of Calif., San Diego, Scripps Inst. of Oceanogr., La Jolla, California 92037). 1972. UNSTRUCTURED MARINE FOOD WEBS AND "POLLUTANT ANALOGUES". NOAA Fishery Bull., 70(3): 1053-1059.

The several species of fish living in the Gulf of California have been shown to possess quite different concentrations of cesium (and cesium in respect to potassium) than the same species of fish living in the Salton Sea. The Salton Sea fish display simple trophic steps of concentration, whereas those in the Gulf all show about the same levels. These differences are reasonably well explained by simplified trophic models of the two environments. The concentration factor found in the known and describable food chain of the Salton Sea, applied to a model of an assumed unstructured food web in the Gulf, leads to reasonable results. This suggests that study of the concentrations in marine organisms of such natural trace substances as cesium may lead to an understanding of the trophic position of the organisms, and hence constitute "pollutant analogues" that may yield a better understanding of the existing or potential distribution of pollutants in marine organisms. (Auth.)

15500. Ramsey, John S., and R. Oneal Smitherman (Ala. Coop. Fish. Unit, Auburn Univ., Auburn, Alabama). 1972. DEVELOPMENT OF COLOR PATTERN IN POND-REARED YOUNG OF FIVE Micropterus SPECIES OF SOUTHEASTERN U. S. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 348-356.

Six stocks of Southeastern Micropterus were spawned in earthen ponds, including wild-caught adults of M. coosae (Alabama and Apalachicola races), M. p. punctulatus, M. punctulatus henshalli, and M. notius, and hatchery stock of M. dolomieui. Fry were reared in earthen ponds provided with Pimephales promelas forage. Periodic samples were preserved to determine pigmentation characteristics at different ages and sizes. An illustrated key to species was prepared based on length and juvenal color pattern. Wild-caught specimens of M. salmoides were included for comparison. Color pattern changes progressed at a smaller size in stunted and wild-caught young. (Authors)

15501. Smitherman, R. Oneal, and John S. Ramsey (Dept. of Fish. and Allied Aquacultures, Auburn Univ., Auburn, Alabama). 1972. OBSERVATIONS ON SPAWNING AND GROWTH OF FOUR SPECIES OF BASSES (Micropterus) IN PONDS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 357-365.

Brood stock of basses were obtained from the following locations during March to April, 1969; Micropterus coosae (Alabama race), Alabama River system; M. coosae (Apalachicola race), Apalachicola River system; M. notius, Suwannee River system; M. punctulatus henshalli, Tallapoosa River system; M. p. punctulatus, Apalachicola River system; M. dolomieui, Mammoth Spring National Fish Hatchery, Arkansas. Adult bass of each stock except Suwannee bass spawned during April 5 to May 19, 1969, in 0.04- to 0.1-acre earthen ponds when stocked at 50 to 100 per acre. Suwannee bass possibly had already spawned in their native habitat. However, Suwannee bass spawned in April during both 1970 and 1971. Surface water temperatures and dates when eggs were first observed were as follows: M. p. henshalli - 69 F (April 5, 1969); M. coosae (Alabama race) - 73 F (April 14, 1969); M. dolomieui - 73 F (April 16, 1969); M. p. punctulatus - 74 F (May 3, 1969); M. coosae (Apalachicola race) - 79 F (May 5, 1969); M. notius - 68 F (April 9, 1970), and 68 F (April 17, 1971). Egg sizes varied considerably among species, M. p. henshalli having eggs 1.9 mm in diameter, while the smallest of adult basses, M. coosae (Alabama race) had the largest eggs at 3.5 mm in diameter. Fry from each bass form except M. notius were stocked during May 9 to June 11 into 0.1-acre ponds which contained abundant fathead minnow, Pimephales promelas. Bass were 17 to 41 mm in total length and were stocked at rates of 800 to 3,000 per acre. Rates of growth varied with species and stocking rate, and survival at draining was lowest in M. dolomieui (63.7 percent) and highest 89.9 percent) in M. coosae (Apalachicola race). Another experiment was a comparison of growth of M. p. henshalli, M. coosae (Alabama race), M. coosae (Apalachicola race), and M. dolomieui, in a single fertilized pond. In the pond, survival of the Alabama redeye bass was 100 percent, while that of the Apalachicola redeye bass was only 67 percent. The Alabama race had the least growth rate of the four basses. M. notius fry stocked at 25 mm (272/A) on May 21, 1970, into a pond containing abundant fathead minnow forage grew to 94 mm by July 13, 1970. All fish were lost at this time from oxygen depletion. (Authors)

15502. Tarplee, William H., Jr., Darrell E. Louder, and Andrew J. Weber (N. C. Wildl. Resources Comm., Raleigh, North Carolina). 1972. EVALUATION OF THE EFFECTS OF CHANNELIZATION ON FISH POPULATIONS IN NORTH CAROLINA'S COASTAL PLAIN STREAMS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 431-446.

This research study was designed to determine the degree of damage, if any, to fish populations resulting from channelization, and to determine the rate of recovery, if the damage was significant. This study points out the detrimental effects stream channelization has on fish populations and on the flora and bottom fauna of streams. The study also indicates that following channelization, and with no channel maintenance, nature can ultimately restore a coastal plain stream and its fish

population to a stage reasonably near its natural condition, provided no further alterations of the stream bed, banks, forest canopy, or aquatic vegetation occur. (Authors)

15503. Addison, Joseph H., and Sam L. Spencer (Ala. Dept. of Conserv. and Natural Resources, Game and Fish Div., Fish. Section, Montgomery, Alabama). 1972. PRELIMINARY EVALUATION OF THREE STRAINS OF LARGEMOUTH BASS, Micropterus salmoides (Lacépède), STOCKED IN PONDS IN SOUTH ALABAMA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 366-374.

Seven ponds in South Alabama were stocked with Florida largemouth bass, Micropterus salmoides floridanus (Lesueur), seven with native largemouth bass, M. s. salmoides (Lacépède), and seven with F1 bass. Samples of bass were collected one and two years after stocking to compare growth rates. Major objectives of this study were: to determine which of the three strains of bass grow faster and/or larger in Alabama ponds, to determine if floridanus can successfully be introduced into an established fish population of a 1,000 acre lake, and to compare the effectiveness of the three strains of bass in maintaining a balanced fish population. All three strains of largemouth bass displayed rapid growth in ponds which did not contain a crowded bass population. The fastest growth observed was that of the F1 bass. However, sufficient data has not been obtained in this study to fully evaluate the growth potential of the three strains of largemouth bass. Further evaluation is planned. The number of pyloric caeca proved to be the best single character for separation of the two subspecies of largemouth bass. (Authors)

15504. Smith, Stephen F. (Texas Parks and Wildl. Dept., Marshall, Texas). 1972. EFFECTS OF A THERMAL EFFLUENT ON AQUATIC LIFE IN AN EAST TEXAS RESERVOIR. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 374-384.

Five data collecting stations were designated within Wilkes Reservoir, a 900 surface acre power plant reservoir in Marion County, Texas, to gather information relative to the effects of a steam-electric effluent upon aquatic life. Temperature and dissolved oxygen readings were obtained with a YSI model 51A oxygen meter. Readings taken at designated intervals indicated the degree and extent of the heated water. Dissolved oxygen readings indicated no adverse dissolved oxygen concentrations. Twelve species of fish were collected and examined for external and internal parasites. Almost 59% of 161 game fish specimens, and almost 83% of 50 rough fish specimens were parasitized with trematodes, nematodes, cestodes, acanthocephalans, and parasitic copepods. The extent of parasitization in this reservoir indicated optimum or near optimum temperature conditions throughout the year. Parasitic copepods were more evident on bullhead catfish (Ictalurus sp.) during February, March, and April. There did not appear to be any seasonal fluctuation of parasitization, or degree of infection on other parasites encountered. Plankton samples were collected with a plankton tow net and volumetrically measured in the laboratory. For a given date, the majority of the plankton consisted of copepods and was more numerous in the warmer water. However, plankton abundance within the entire reservoir was greater during the colder periods of the year. Chemical water quality was checked with a Hach DR EL portable chemistry kit and did not undergo any significant changes. Fish were collected in water with temperatures in excess of 100 F, surface temperature 107 F on afternoon of collection. Specimens netted in this heated water had high mortality rates. (Auth.)

15505. Barkley, Sammy W., and Carl Perrin (Ark. Game and Fish Comm., Little Rock, Arkansas). 1972. THE EFFECTS OF THE LAKE CATHERINE STEAM ELECTRIC PLANT EFFLUENT ON THE DISTRIBUTION OF FISHES IN THE RECEIVING EMBAYMENT. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 384-392.

In 1967 the Arkansas Power and Light Company and the Arkansas Game and Fish Commission cooperated in a joint project to determine any changes in the stratification, flow pattern, and basic water quality in the lower end of Lake Catherine and in the Ouachita River below Remmel Dam as affected by the increased

cooling water output and water temperature resulting from the construction of a new power unit proposed for the Lake Catherine Steam Electric Station, Hot Spring County, Arkansas. A follow-up study of the project was conducted in the summer of 1970 to obtain post-installation data to be compared to that information recorded previously in 1967. In connection with this project, nine gill netting samples were made during the period February 25, 1970 to January 16, 1971 to determine the effects of the plant effluent on the distribution of fishes within the receiving embayment. Using five nets of varying mesh sizes, set overnight in predetermined locations, a total of eight hundred and forty-seven (847) fish were collected weighing eight hundred and twenty-six and seven tenths (826.7) pounds. A seasonal migration of fishes was evident as a greater poundage of fishes was collected in winter samples than in summer. Individual species were graphed to show dominant fishes during winter and egress of particular species in summer. A direct correlation could not be made between fishes present in the bay and water temperatures. The maximum water temperature was 90°F. The average temperature in the effluent receiving bay in the summer of 1970 was 84°F which is very near the optimum growth temperature for most of the native warmwater species of fish in Lake Catherine. An obvious relationship was noted between the availability of food and dissolved oxygen concentrations to the abundance of fishes within the receiving embayment. (Authors)

15506. DeMont, David J., and Roy W. Miller (Div. of Inland Fisheries, No. Carolina Wildl. Resources Comm., Raleigh, North Carolina). 1972. FIRST REPORTED INCIDENCE OF GAS-BUBBLE DISEASE IN THE HEATED EFFLUENT OF A STEAM GENERATING STATION. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 392-399.

During the winter of 1970-71, thirteen species of warm-water fishes exhibited external symptoms of gas-bubble disease (mostly "pop-eye") in the discharge canal and cove of a steam generating station. Peak monthly incidences were 70.8, 33.3, and 23.5 percent for white bass, threadfin shad, and bulegill, respectively. Forty-nine percent of the bluegill in excess of 4 inches were afflicted, whereas only 4.4 percent of those under 4 inches exhibited symptoms. Among the bluegill, the right eye only symptoms were more prevalent than were the left eye only symptoms at the 97.5 percent confidence level. Dead fish, principally black crappie, observed in the discharge in February, 1971 did not exhibit external symptoms of gas-bubble disease. However, autopsies of dying black crappie revealed gas emboli in the larger vessels of the gill fragments. (Authors)

15507. England, Russell H., and Kenneth B. Cumming (Va. Polytech. Inst. and State Univ. Coop. Fishery Unit, Bur. of Sport Fish. & Wildl., Blacksburg, Virginia). 1972. STREAM DAMAGE FROM MANGANESE STRIP-MINING. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 399-418.

Abandoned manganese strip mines in Smyth County, Virginia have for many years contributed pollution to the streams draining them. Streams in the Cripple Creek drainage area were sampled during the summer of 1967 to determine the nature and extent of pollution in them, and to evaluate the reclamation work being done by the United States Forest Service. Affected streams were compared with control streams on the basis of physical, chemical and biological properties. Manganese levels in all streams sampled were found to be below one part per million. A controlled experiment with $Mn(NO_3)_2$ showed that the median tolerance limit for rainbow trout fingerlings is about 16 ppm Mn, which, together with stream sampling data, indicates that manganese is not present in toxic concentrations in the study streams. Killinger Creek, which drains a partially reclaimed area, was found to support fewer species of fish and benthic fauna than Crigger Creek, a comparable control stream. Siltation is probably the main contributing factor. Bedload was much greater in affected streams than in control streams. Although volume of bedload was high in Blue Spring Creek, which drains a reclaimed area, particle size distribution of the bedload indicates that much of the finest silt has been flushed from the upper portion of this stream. Blue Spring Creek supports an abundant population of aquatic insects and fish fauna, indicating that reclamation

has been effective on this watershed. It was also found that rainbow trout are spawning successfully in this stream. (Authors)

15508. Boyd, Claude E. (Dept. of Fish. and Allied Aquacultures, Auburn Univ. Agric. Exp. Sta., Auburn, Alabama). 1972. PHOSPHORUS DYNAMICS IN PONDS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 418-426.

A qualitative model of the phosphorus dynamics of a pond is presented. Most of the possible inputs, transfers, and losses are likely important in infertile, unfertilized ponds. The involvement of sediment probably regulates the phosphorus status of most unfertilized ponds. Furthermore, the native fertility of ponds is directly related to the fertility of underlaying and surrounding soil. Fertilization is probably the only significant phosphorus input to well-managed ponds. In fertilized ponds the sediment is a phosphorus sink. Continual additions of phosphorus maintain the high levels of photosynthesis. Phosphorus transfers from water to phytoplankton and finally to fish are of major significance. Significant loss from fertilized ponds are uptake by sediment, seepage, and fish harvest. Once sediments become saturated with phosphorus, equilibrium concentrations will probably increase to a level where the rate of fertilization can be lowered. (Auth. conclusions and summ.)

15509. Smith, Barry W., and R. T. Lovell (Dept. of Fish. and Allied Aquacultures, Auburn Univ., Auburn, Alabama). 1972. DIGESTIBILITY OF NUTRIENTS IN SEMI-PURIFIED RATIONS BY CHANNEL CATFISH IN STAINLESS STEEL TROUGHS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 452-459.

The digestibility of nutrients in six semi-purified rations containing variable levels of protein, cellulose and starch by channel catfish in troughs was evaluated by using chromium oxide as an inert reference in the feeds. Excreta were collected using an indirect trough collection method and a direct intestinal collection method. Digestibility coefficients determined on excreta collected in troughs were higher than coefficients determined from excreta collected from the intestine. There was no significant difference in protein or fat digestibility from the six rations when the trough collection of excreta method was used. In the intestinal collection method, excreta were collected, separately, from four areas of the digestive tract, namely, the stomach, upper intestine, lower intestine and rectum. The absorption of protein in two-year old channel catfish occurred the length of the intestine up to and possibly including the rectum. There was a significant difference in protein digestibility among the six rations for collection of excreta from the rectal area. A higher percentage of protein was digested in rations containing 40% protein than in those containing 20% protein. Starch did not seem to affect protein digestibility but cellulose did. Protein digestibility coefficients ranged from 72 to 93%. (Authors)

15510. Lewis, Sue D. (Fish. Res. Lab., Southern Ill. Univ., Carbondale, Illinois). 1972. EFFECT OF SELECTED CONCENTRATIONS OF SODIUM CHLORIDE ON THE GROWTH OF CHANNEL CATFISH. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 459-466.

A number of studies have been done on the tolerance of fish to salt, but there is little information on the effect of salt on growth of fish. In the present study, repeated trials in tanks indicated that selected concentrations of salt have a significant effect on the growth of channel catfish. Subsequent trials in ponds showed a similar effect. The increased growth resulting from selected concentrations of salt is of such magnitude as to be of practical significance in some situations. An explanation for this effect is postulated. (Auth.)

15511. Courtney, Charles H., and John K. Reed (Dept. of Entom. and Econ. Zool., Clemson Univ., Clemson, South Carolina 29631). 1972. ACCUMULATION OF DDT FROM FOOD AND FROM WATER BY GOLDEN SHINER MINNOWS, Notemigonus crysoleucas. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 426-431.

15512. Perry, W. Guthrie, Jr., and James W. Avault, Jr. (La. Wild Life and Fisheries Comm., Grand Chenier, Louisiana). 1972. POLYCULTURE STUDIES WITH BLUE, WHITE AND CHANNEL CATFISH IN BRACKISH WATER PONDS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 466-479.

This paper includes a discussion of a catfish polyculture experiment conducted in brackish water ponds at the Rockefeller Wildlife Refuge, Grand Chenier, Louisiana. Ponds containing channel catfish (Ictalurus punctatus) only served as controls and were compared to other ponds containing various stocking ratios of blue (I. furcatus), channel and white catfish (I. catus) to determine if production could be increased. Length-weight relationships, coefficients of condition, food conversions, survival and growth data were compared in an analysis of the various stocking combinations. These data supported by that of past studies demonstrated that channel catfish grown under monoculture conditions exhibited the best survival, food conversion, coefficient of condition and growth. It is also stressed that we believe the culture of mixed species to be nearing practicality and may be a future requirement in order to realize additional profits from fish farming operations. New species and stocking ratios should be explored to obtain maximum yields. (Authors)

15513. Greene, George N. (Auburn Univ., Agric. Exp. Sta., Auburn, Alabama). 1972. BIOLOGICAL FILTERS FOR INCREASED FISH PRODUCTION. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 483-489.

Recirculation and biofiltration of the water in fish ponds yielded a net production of catfish of over 19,300 lb/acre. Channel catfish and white catfish responded similarly to the filtered water system. Filtration improved the water quality in the pond by reducing ammonia, organic carbon, nitrite and turbidity and possible increasing dissolved oxygen. At higher stocking rates (4,000 lb/acre) a settling basin in series with the filter had no effect on the fish production but did cause a 20.6% increase in production at low stocking rates (2,000 lb/acre). As a result of crowding of the fish, diseases and parasites were a major problem. (Auth. summ. and conclusions)

15514. Plumb, John A. (Southeastern Coop. Fish Disease Project, Dept. of Fish. and Allied Aquacultures, Auburn Univ., Auburn, Alabama). 1972. CHANNEL CATFISH VIRUS DISEASE IN SOUTHERN UNITED STATES. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 489-493.

Channel catfish virus disease is caused by a specific virus which has been isolated from 23 epizootics reported from nine different states. This paper gives clinical signs, mortality patterns and susceptibility of different age and size fish to channel catfish virus. Recommended practices for controlling the disease are presented. (Auth.)

15515. Rogers, Wilmer A. (Dept. of Fish. and Allied Aquaculture, Agric. Exp. Sta., Auburn Univ., Auburn, Alabama). 1972. DISEASE IN FISH DUE TO THE PROTOZOAN Epistylis (CILIATE: PERITRICHA) IN THE SOUTHEASTERN U. S. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 493-496.

"Red-sore" disease of fishes caused by the stalked ciliate Epistylis, is very common and widespread in the Southeastern U. S. Epizootics occur most frequently during the winter and spring months. Research has shown that this species is not an obligate parasite but only uses the host fish as an attachment site. The disc-like attachment organelle, penetrating the skin of the fish, apparently secretes an enzyme that dissolves the fishes' scales or spines and produces pit-like inflamed lesions. Bacterial infections often occur secondarily to the Epistylis infestation. Observations of the life history have shown a formation of telotrochs which are characteristic of the order Peritricha. Preliminary laboratory tests show that a single treatment with potassium permanganate at a rate of 2 ppm or formalin at a rate of 15 ppm will control Epistylis. (Auth.)

15516. Gaines, John L., Jr., and W. A. Rogers (Dept. of Fish. and Allied Aquacultures, Fish. Lab., Agric. Exp. Sta., Auburn Univ., Auburn, Alabama). 1972. FISH MORTALITIES ASSOCIATED WITH Goezia sp. (NEMATODA: ASCAROIDEA) IN CENTRAL FLORIDA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 496-497.

This is the first report of Goezia sp. from freshwater fish in North America. Extensive mortalities among striped bass (Morone saxatilis) resulted from the damage caused by these nematodes. A possible mode of infection is given and a discussion of the pathology associated with the worms is presented. (Authors)

15517. Lewis, D. H. (Dept. of Vet. Microbiol., Coll. of Vet. Med., Texas A&M Univ., College Station, Texas). 1972. IMMUNOFLUORESCENT TECHNIQUES APPLICABLE TO DETECTING Aeromonas liquefaciens. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 498-500.

The use of fluorescent labelled antibody (FA) systems provide a means for detecting both the presence of the agent, Aeromonas liquefaciens and fish antibodies to that agent. Bacteria from experimentally infected fish could be identified within 6 hours after obtaining the sample by the FA technique. The preparation of specific antiserum to A. liquefaciens and a proposed method for rapid detection of the bacterium from field specimens is presented. (Auth.)

15518. Harper, Jack L., and Ron Jarman (Okla. Dept. of Wildl. Conservation, Oklahoma City, Oklahoma). 1972. INVESTIGATION OF STRIPED BASS, Morone saxatilis (Walbaum), CULTURE IN OKLAHOMA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 501-512.

Various stocking rates were tested over a three year period for production of striped bass in culture ponds. Rates ranged from 10,000 to 160,000 fry per acre. Results indicate higher rates produced as high a percent yield as lower rates. Four food types were also tested during this period to determine which produced the best yields. Commercially prepared supplemental feeds did increase production over natural foods. Food habits data support earlier information that Copepoda, Cladocera and Insecta are important food organisms to juvenile striped bass. (Authors)

15519. Erickson, Kim E., Jack Harper, Gary C. Mensinger and Don Hicks (Okla. Dept. of Wildl. Conservation, Oklahoma City, Oklahoma). 1972. STATUS AND ARTIFICIAL REPRODUCTION OF STRIPED BASS FROM KEYSTONE RESERVOIR, OKLAHOMA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 513-522.

The investigation to verify striped bass, Morone saxatilis (Walbaum), reproduction in Keystone Reservoir utilized egg sampling and shoreline seining methods. Conditions in the Arkansas River throughout the egg sampling period were unfavorable and seemed to indicate little chance for a successful spawn. However, on June 21, 1971, natural reproduction was verified. The total 1971 fingerling survival was calculated at 975,000. Ten mature females and four male striped bass were taken below Keystone dam by electrofishing during the period May 24 to June 3, 1971. These fish were transported 150 miles to hatchery facilities where artificial spawning was conducted. One seven-pound female was successfully spawned and fry were produced. Problems, procedures and resulting recommendations are discussed. Age and growth determinations and length-weight relationships are presented. (Authors)

15520. Humphries, Earl T., and Kenneth B. Cumming (Div. of Forestry and Wildl. Sciences of Va. Polytech. Inst., Va. Coop. Fish. Unit., Bureau of Sport Fish. & Wildl., Blacksburg, Virginia). 1972. FOOD HABITS AND FEEDING SELECTIVITY OF STRIPED BASS FINGERLINGS IN CULTURE PONDS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 522-536.

Stomach content analyses were performed on 213 striped bass (11.4-80.0 mm

TL) collected from culture ponds at the Front Royal Fish Cultural Station, Virginia, during the 1969 and 1970 rearing seasons. Cladocerans (families Sididae, Daphnidae and Bosminidae) constituted the major portion of the diet of these fish with copepods (family Cyclopidae) and insects (family Chironomidae) also being important food organisms. Cladoceran abundance in the stomachs increased after the bass were 30-40 mm long, while copepod abundance decreased and insect abundance remained relatively stable. The fish negatively selected Brachionidae (rotifers) and copepod nauplii. Daphnidae and Bosminidae were positively selected and Cyclopidae was eaten in relation to its abundance in the ponds. Sididae was positively selected when present in small numbers, but eaten in proportion to its abundance when present in large numbers. (Authors)

15521. Williams, Hampton M. (So. Carolina Wildl. Resources Dept., Charleston, South Carolina). 1972. PRELIMINARY FECUNDITY STUDIES OF THE HYBRID (STRIPED BASS X WHITE BASS) IN TWO SOUTH CAROLINA RESERVOIRS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 536-542.

The ovaries of 28 mature female hybrids, striped bass Morone saxatilis (Walbaum) X white bass Morone chrysops (Rafinesque) from Lakes Hartwell and Clark Hill were utilized in determining fecundity in this oviparous species. These data were collected from all year classes present that were sexually mature, which included year classes I, II, and III. No females of year class 0 were captured during these studies. Many hybrid males one year of age were caught at the spawning grounds and specimens as small as 269 mm in total length appeared to be sexually mature. Female hybrids as small as 409 mm in total length and some weighing as little as 917 grams were found to be sexually mature. Mean ova production although increasing in direct proportion to age, total length and body weight remained rather constant as to average number of eggs per pound of body weight. Total ova production ranged from a minimum of 185,000 in a 2.9 pound two year old fish to a maximum of 1,152,000 in a 6.3 pound four year old specimen. Mean number of eggs per pound of body weight from all 28 hybrids was 160,000. (Auth.)

15522. Reeves, William C., and Jerome F. Germann (Dept. of Fish. and Allied Aquacultures, Auburn Univ., Auburn, Alabama). 1972. EFFECTS OF INCREASED WATER HARDNESS, SOURCE OF FRY AND AGE AT STOCKING ON SURVIVAL OF STRIPED BASS FLY IN EARTHEN PONDS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 542-548.

Research on the extensive culture of striped bass, Morone saxatilis (Walbaum), was conducted in ponds at Auburn University Fisheries Research Unit in the spring of 1971. Investigations were conducted to determine the effect of water hardness, source of fry and immediate versus delayed stocking on the survival of striped bass fry. Twelve 0.10-acre earthen ponds were used. Six ponds were treated with calcium sulfate to raise the hardness to 150 ppm. The hardness of the remaining ponds was approximately 20 ppm. Striped bass fry from two sources (Cooper River, South Carolina, and Savannah River, Georgia) were stocked immediately after receiving them from the hatchery or after they began feeding. Stocking rates varied from 60,000/A to 210,000/A. There was no difference in survival between sources of fry. Delayed stocking increased the survival rate of striped bass once they were stocked in the ponds; however, many fry from each source died in holding prior to stocking into the ponds. Increasing the water hardness did not increase the survival of striped bass. On the contrary, survival of striped bass in soft water ponds was higher than the survival in hard water ponds. (Authors)

15523. Resh, V. H., R. D. Hoyt, and S. E. Neff (Water Resources Lab., Univ. of Louisville, Louisville, Kentucky 40208). 1972. THE STATUS OF THE COMMON SHINER, Notropis cornutus chrysocephalus (Rafinesque), IN KENTUCKY. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 550-556.

Fishes belonging to the Notropis cornutus complex are commonly encountered

by hydrobiologists. Consequently, a reasonable taxonomic designation of these forms is important. Several attempts have been made to place these fishes in an acceptable classification. To clarify the status of their classification, specimens sampled from collections totaling more than 3400 fish from 40 counties in Kentucky were analyzed for dorsal stripe configuration, chin pigmentation, and anterior dorsolateral and circumferential scale counts. Distribution and meristics of shiner populations presented in this and other studies suggest that the cornutus-chrysocephalus complex forms a cline extending from the Gulf coast northward to the Great Lakes region. There is a general pattern of increasing scale counts of circumferential and anterior dorsolateral scales from south to north. The variations in pigmentation patterns and scale counts appear to be the result of differing environmental conditions and may be considered as "neutral" phenotypes. Most specimens examined from Kentucky conform to the description of the form chrysocephalus. Alternative views of the complex by other workers are presented. (Authors)

15524. Davis, James R. (Div. of Inland Fish., No. Carolina Wildl. Resources Comm., Raleigh, North Carolina). 1972. THE SPAWNING BEHAVIOR, FECUNDITY RATES, AND FOOD HABITS OF THE REDBREAST SUNFISH IN SOUTHEASTERN NORTH CAROLINA. Proc. of the 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 556-560.

Redbreast sunfish Lepomis auritus (Linnaeus) were found to spawn during June at water temperatures of 71° to 78°F. Redbreast sunfish redds were almost identical in design and size in the Lumber, Waccamaw, and the South Rivers. Each redd was located in or near a sheltered area such as a log, fallen tree, or stump. The preferred bottom substrate for spawning was sand and small gravel. No redds were observed in silt or detritus. Age II, III, IV, V, and VI year redbreast sunfish had mean egg counts of 963, 1,000, 3,563, 5,620, and 8,250, respectively, with corresponding standard deviations of 88.4, 435.9, 763.1, 851.9, and 278.4. The most important food items found in the redbreast sunfish stomachs were aquatic insects, represented by Coleoptera, Odonata, and Ephemeroptera. It appeared that redbreast sunfish were selective and preferred the larger mayfly, dragonfly, and beetle larvae found in the streams. When confined to aquaria, redbreast sunfish preferred live food items such as worms, crickets, grubs, and grasshoppers over artificial foods. (Auth.)

15525. Smith, William B. (Div. of Inland Fish., N. C. Wildl. Resources Comm., Raleigh, North Carolina). 1972. THE BIOLOGY OF THE ROANOKE BASS, Ambloplites cavifrons Cope, IN NORTH CAROLINA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 561-570.

This paper summarizes the final report on the investigation of the Roanoke bass in North Carolina. It contains new data on recognition characters, distribution, food studies, sexual maturity, and age-and-growth studies which essentially augments the report "A Preliminary Report on the Biology of the Roanoke Bass, Ambloplites cavifrons Cope, in North Carolina" Smith, 1969, presented in the 23rd Southeastern Proceedings, 1969. (Auth.)

15526. Holcomb, Dennis, and William Wegener (Fla. Game and Fresh Water Fish Comm., Eustis, Florida). 1972. HYDROPHYTIC CHANGES RELATED TO LAKE FLUCTUATION AS MEASURED BY POINT TRANSECTS. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 570-583.

In the spring of 1970 and 1971, vegetation transects were run on 22,700 acre Lake Tohopekaliga in Osceola County, Florida. The objective of this study was to monitor the response of various plant types to a 7 foot drawdown and compare results with those from a study done in 1956. As a result of dewatering, littoral vegetation advanced lakeward, expanding from an area of approximately 9,000 acres to 10,500 acres, a 16% increase. The significance of this plant response, relative to standing crop of fish and invertebrate fish-food organisms, is discussed. Five of 16 dominant plant types occurred most frequently or had widest

distribution during a high water period (1970). The remaining 11 occurred most frequently or had widest distribution during low water periods (1956 and 1971). In the 1956 study it was assumed that water stage duration determined the distribution of annual and perennial plants. Data from the present study indicate distribution of vegetation within Tohopekaliga's basin is determined mainly by prevailing water levels during the growing season. The lakeward limit of perennial emergents is related to historically low water elevations. (Authors)

15527. Parrish, Patrick R. (EPA, Gulf Breeze Lab., Sabine Island, Gulf Breeze, Florida). 1972. A RESPIROMETER FOR DETERMINING THE EFFECT OF PESTICIDES AND RELATED POLLUTANTS ON OXYGEN CONSUMPTION OF ESTUARINE FISHES. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 602-606.

A continuous-flow respirometer was constructed to measure the effect of pesticides and related pollutants on oxygen consumption of estuarine fishes. The parts of the respirometer in contact with pollutants were constructed of glass and teflon for efficiency in cleaning. Filtered, irradiated sea water of constant temperature and salinity was gravity-fed through ten experimental and ten control respiration chambers in which individual fish were held. Flow rates through the chambers were controlled by stopcocks and measured by flowmeters. Dissolved oxygen was determined by the Winkler method before and after water passed through each chamber. Pollutants were metered into the experimental chambers by syringe pump. (Auth.)

15528. Summerfelt, Robert C., and Larry Hart (Okla. Coop. Fish. Unit, Okla. State Univ., Stillwater, Oklahoma). 1972. PERFORMANCE EVALUATION OF A 74 KILOCYCLE/SECOND TRANSMITTER FOR BEHAVIORAL STUDIES ON RESERVOIR FISHES. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 607-622.

Ultrasonic transmitters were commercially purchased. They were cylindrical in shape, 90 mm long by 19 mm in diameter, and they weighed 29.5 g, with battery, in water. They transmitted at a frequency of 74 kilocycles/second. The number of days of active transmission was related to battery type and impulse rate. Transmitters emitting a greater number of impulses per second, with a range of 2.4 to 5.8, tended to stop transmitting sooner than those emitting fewer impulses per second. The difference in longevity between a 3 and 6 impulse per second transmitter was estimated to be 14 days. The average transmitting life of 11 transmitters was 30.5 days, with a range from 24 to 52 days. Battery capacity was a significant factor affecting longevity; transmitters with a 160 milliamperehour battery had an average longevity of only 18.5 days. None of the tags had a transmitting life equal to the 60 days advertised by the manufacturer. Within a range of 5 to 30 C, temperature was not a significant factor affecting the life span of the transmitter, although there was an indication that higher temperature slightly increased impulse rate which reduced total longevity. Impulse rate of individual transmitters is used to distinguish different fish in a body of water. The impulse rate of each transmitter increased sharply during the last few days of operation which produced greater overlap in impulse rates than prior to this change. The average deviation of impulse rate was much greater than the 10% tolerance specified by the manufacturer. Turbidity within a range of 8.7 to 41.2 ppm SiO_2 had little effect on transmission range. Wind, apparently due to its effect on waves, was found to add background noise which interfers with sensing impulses. Transmission range averaged 280 m and varied from 150 to 576 meters. Transmission range of a 74 k transmitter was not less when surgically implanted in the abdomen of a flathead catfish than the range of the same transmitter outside the body of the fish. (Authors)

15529. Lugaski, Thomas (Univ. of Nevada, Reno, Nevada). 1972. A NEW SPECIES OF SPECKLE DACE FROM BIG SMOKY VALLEY, NEVADA. Biological Society of Nevada, Occasional Papers, No. 30, 8 p., illus.

15530. Starling, Charles C. (Fla. Game and Fresh Water Fish Comm., Fish. Research Lab., Eustis, Florida). 1972. HANDPICKING MACROINVERTEBRATES; THREE METHODS COMPARED. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 622-626.

Benthic samples were sorted by three methods: electrical stimulus applied to living organisms, preserved in rose bengal formalin solution, and preserved natural-colored. The rose bengal stained samples were picked most accurately and rapidly except in very low invertebrate concentrations where the electrical stimulus was more efficient. Natural-colored samples had the least accurate retrieval and were picked at a rate intermediate to the other two methods. (Auth.)

15531. Manooch, Charles S., III (N. C. State Univ., Dept. of Zool., Raleigh, North Carolina). 1972. CULTURING, A METHOD USED TO IDENTIFY ALGAE INGESTED BY TILAPIA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 626-635.

Bold's Basal and Gorham's media were used to culture algae removed from the digestive tracts of Blue Tilapia, Tilapia aurea (Steindachner). Nine fish representing three-size categories collected from Lake Parker, Florida, were used in the study. Samples extracted from three areas of the gut were introduced to the culture media within twenty-four hours after collection. Microscopic examination of the cultured materials was conducted over a four-week period to enable the completion of reproductive cycles and excystment of algal cells. Twenty-one taxa of algae were identified by sampling the culture vessels. Planktonic green algae were the dominant foods of tilapia at the time of sampling. Species of Scenedesmus, Pediastrum, Ankistrodesmus and chlorococcoid algae appeared in all specimens. Colonial chlorophytes, pennate diatoms, flagellated unicells, and remains of filamentous algae occurred less frequently. Spirulina sp. was the only blue-green occurring in significant quantities. Two rotifers, two ostracods, and a cladoceran were the only zooplankters observed. Both, type of media used and region of gut sampled, produced slight quantitative and qualitative differences in data obtained. Maximum taxonomic diversity was encountered in the anterior samples cultured in Bold's Basal medium. Bacterial conditions in the digestive systems had no inhibitory effect on culturing algae. The method of culturing ingested materials definitely has a future in specialized fisheries research programs. It would be particularly useful in studying dietary habits of juvenile fish and other small aquatic organisms (crustaceans and mollusks). (Auth.)

15532. Hoss, Donald E., Linda C. Coston, and William F. Hettler, Jr. (NMFS, Mid-Atlantic Coastal Fish. Res. Center, Beaufort, North Carolina). 1972. EFFECTS OF INCREASED TEMPERATURE ON POST-LARVAL AND JUVENILE ESTUARINE FISH. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 635-642.

We simulated thermal increases encountered by postlarval and juvenile estuarine fishes entrained in power plant cooling systems. Three methods were used to measure the effects of thermal shock on these fishes: (1) critical thermal maximum (CTM); (2) changes in routine oxygen consumption; and (3) survival after exposure to sudden increases in temperature for various periods of time. For menhaden, spot, and pinfish acclimated at 15°C, CTM values were 29.4, 31.0, and 31.0 respectively. Oxygen consumption of menhaden, spot, and pinfish, increased as we raised the temperature in 5° increments from the environmental temperature indicating that additional energy expenditures are necessary to maintain the fish at the elevated temperatures. At temperatures of 15°C above the normal environmental temperature, all of the menhaden, spot, and pinfish died within 5 to 10 minutes. Young striped killifish acclimated at 22°C survived at 39°C for more than 30 minutes but all died at 40°C. (Authors)

15533. Laflin, Bonny Dale, and Peter W. Pfeiffer. 1972. A GUIDE TO 28 PUBLIC FISHING LAKES. Kentucky Dept. of Fish and Wildlife Resources, Frankfort, Kentucky, 83 p., illus., maps, charts.

15534. Mills, Earl R., and Dudley D. Culley, Jr. (Texas A&M Marine Lab., Galveston, Texas). 1972. TOXICITY OF VARIOUS OFF-SHORE CRUDE OILS AND DISPERSANTS TO MARINE AND ESTUARINE SHRIMP. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 642-650.

The acute effects of four crude oils and two oil spill removers on four species of marine shrimp (Penaeus setiferus, P. aztecus, Palaemonetes vulgaris, and P. pugio) were determined. Results of 48-hour bioassays showed that distinctive differences in toxicity existed between crude oils from different areas with all shrimp tested. The oil spill removers were much more toxic than the crude oils. Addition of the oil spill removers to all crude oils at recommended application ratios increased the toxicity of both the crude oils and the oil spill removers indicating a synergistic effect. The Palaemonetes species appeared more tolerant to all toxicants. Evidence indicates that the most serious effects of oil pollution would be noted in the shallower areas where high concentrations of toxic compounds may build up. (Authors)

15535. De La Bretonne, Larry, Jr., and James W. Avault, Jr. (Fish. Div., Louisiana State Univ., Baton Rouge, Louisiana). 1972. MOVEMENTS OF BROWN SHRIMP, Penaeus aztecus, AND WHITE SHRIMP, Penaeus setiferus, OVER WEIRS IN MARSHES OF SOUTH LOUISIANA. Proc. of 25th Ann. Conf. Southeastern Assoc. of Game and Fish Commissioners October 17-20, 1971, pp. 651-654.

The movements of brown shrimp (Penaeus aztecus) and white shrimp (P. setiferus) over weirs in a South Louisiana estuary were influenced by tides. Brown shrimp concentrations inside the weir were greatest on incoming tides, water flowing into the weired area. The incoming water stimulated brown shrimp to the weir. White shrimp concentrations inside the weir depended on water head differences between weired and outside waters. The head difference usually occurred with approaching cold fronts and drops in temperature. The shrimp catch was greatest at night. (Authors)

15536. Gibbons, John R. H., and John H. Gee (Dept. of Zool., Univ. of Manitoba, Winnipeg, Manitoba, Canada). 1972. ECOLOGICAL SEGREGATION BETWEEN LONGNOSE AND BLACKNOSE DACE (GENUS Rhinichthys) IN THE MINK RIVER, MANITOBA. J. Fish. Res. Bd. Canada, 29(9): 1245-1252.

Longnose and blacknose dace occur in greatest abundance in the middle zone of the Mink River, and segregation in environment occupied is marked. Newly emerged longnose fry were found in stream margins, but by the middle of their first summer had moved into fast riffles (> 45 cm/sec) where they completed their life cycle. Blacknose fry also occupied stream margins, remaining there for up to one year. Thereafter they were found mostly in channels of moderate current. Coexistence of fry of the two species in stream margins is minimized by earlier hatching of longnose dace. Diet of longnose and blacknose dace, consisting of aquatic insect larvae and nymphs, was strikingly similar. (Authors)

15537. Beamish, F. W. H., and I. C. Potter (Dept. of Zool., College of Biol. Sci., Univ. of Guelph, Guelph, Ontario, Canada). 1972. TIMING OF CHANGES IN THE BLOOD, MORPHOLOGY, AND BEHAVIOR OF Petromyzon marinus DURING METAMORPHOSIS. J. Fish. Res. Bd. Canada, 29(9): 1277-1282.

Morphological, biochemical, and behavioral criteria, from samples collected from 1969 to 1971, showed that metamorphosis in P. marinus is of a relatively short duration. In an analysis of sequential catches during 1971, the first external signs of transformation were observed only in samples caught between July 12 and 26, illustrating the marked synchrony characteristic of this and subsequent developmental stages. Relative increases in size of the disc and snout were most marked from mid-August to late October. Polyacrylamide gel electrophoresis showed that the change-over from larval to adult hemoglobins took place mainly between early August and late October, the beginning and peak of this process being characterized by reduced hematocrit values. Over 95% of the animals captured at various times in the field commenced feeding on suckers (Catostomus commersoni) in the laboratory by late November or early December. (Authors)

15538. Lovett, Raymond J., Walter H. Gutenmann, Irene S. Pakkala, William D. Youngs, Donald J. Lisk, George E. Burdick, and Earl J. Harris (Dept. of Entomol., N. Y. State Coll. of Agric. and Life Sciences, Cornell Univ., Ithaca, New York 14850). 1972. A SURVEY OF THE TOTAL CADMIUM CONTENT OF 406 FISH FROM 49 NEW YORK STATE FRESH WATERS. J. Fish. Res. Bd. Canada, 29(9): 1283-1290.

Fish from New York State fresh waters were surveyed for total cadmium. The majority of samples contained 20 ppb or below. The remainder showed concentrations up to 100 ppb with only few above this concentration. Fishes from central New York waters rarely contained cadmium greater than 20 ppb. Fish from Adirondack waters contained cadmium above 20 ppb most consistently. These higher concentrations may be related to generally higher background cadmium levels in this Adirondack area where many metallic ore deposits are located with which cadmium is typically associated. Cadmium accumulation only occasionally appeared species-dependent. No relation was obvious between total residues of the metal and size or sex of fish or age of lake trout. The cadmium concentrations observed are comparable to those commonly present in many other foods. (Authors)

15539. Fletcher, G. L., and R. J. Hoyle (Fish. Res. Bd. of Canada, Halifax Lab., Halifax, Nova Scotia, Canada). 1972. ACUTE TOXICITY OF YELLOW PHOSPHORUS TO ATLANTIC COD (Gadus morhua) AND ATLANTIC SALMON (Salmo salar) SMOLTS. J. Fish. Res. Bd. Canada, 29(9): 1295-1301.

The acute toxicity of yellow phosphorus (P_4) to Atlantic cod (Gadus morhua) and Atlantic salmon smolts (Salmo salar) was investigated using two experimental procedures: (a) continuous exposure and (b) single brief exposure. In continuous-exposure experiments, P_4 was lethal to cod and seawater-maintained salmon at concentrations as low as 1.89 and 0.79 μg/liter, respectively. Salmon that were exposed to P_4 concentrations of 40 μg/liter or less developed a distinct external red color and showed signs of extensive hemolysis. At death, salmon that had been exposed to P_4 concentrations of 90 μg/liter and lower showed a progressive decline in hematocrits. In contrast, cod were never observed to show any evidence of external redness, hemolysis, or reduced hematocrits. In the brief-exposure experiments, cod and salmon were subjected (20 min to 3.5 hr) to P_4 concentrations ranging from 245 to 4030 μg/liter. These brief exposures resulted in mortalities to both species that were delayed for as long as 2 weeks. Salmon turned "red" 16-24 hr following exposure, and at death showed evidence of hemolysis and reduced hematocrits. None of the cod exhibited any of these symptoms. (Authors)

15540. Lehmkuhl, D. M. (Dept. of Biol., Univ. of Saskatchewan, Saskatoon, Saskatchewan, Canada). 1972. CHANGE IN THERMAL REGIME AS A CAUSE OF REDUCTION OF BENTHIC FAUNA DOWNSTREAM OF A RESERVOIR. J. Fish. Res. Bd. Canada, 29(9): 1329-1332.

The kinds and numbers of Ephemeroptera and other insects in the Saskatchewan River are greatly reduced downstream of a dam. This is attributed to changes in river temperatures caused by the reservoir. The river is warmed in winter and cooled in summer. Consequently, mayflies and other insects with strict thermal requirements cannot hatch and grow successfully. The effect is evident 70 miles downstream. (Auth.)

15541. Davy, F. B., and H. Kleerekoper, and P. Gensler (Inst. of Life Science, Texas A&M Univ., College Station, Texas 77843). 1972. EFFECTS OF EXPOSURE TO SUBLETHAL DDT ON THE LOCOMOTOR BEHAVIOR OF THE GOLDFISH (Carassius auratus). J. Fish. Res. Bd. Canada, 29(9): 1333-1336.

A highly significant time-dependent correlation between consecutive turns in the locomotor pattern of normal goldfish (Carassius auratus), attributed to a "memory" process in the pertaining locomotor control mechanism in the central nervous system, is significantly reduced within 4 days by chronic exposure of the fish to 10 μg/liter p,p'-DDT. Keeping the fish in clean water during 130-139 days did not result in the restoration of the above correlation. (Authors)

15542. Houston, A. H., and R. J. Woods (Med. Coll. of Wisconsin, Milwaukee, Wisconsin 53233). 1972. BLOOD CONCENTRATIONS OF TRICAINE METHANE SULPHONATE IN BROOK TROUT, Salvelinus fontinalis, DURING ANESTHETIZATION, BRANCHIAL IRRIGATION, AND RECOVERY. J. Fish. Res. Bd. Canada, 29(9): 1344-1346.

Blood concentrations of tricaine methane sulphonate increased rapidly upon immersion of trout in 100 mg/liter solutions of the anesthetic at 3.5-5 C, and also rose significantly during irrigation for 15 min with either 50 or 100 mg/liter solutions. Clearance was rapid following transfer to running freshwater recovery tanks. Graphical estimates of 50 and 90% blood clearance times were 20 and 55 min, respectively. (Authors)

15543. Hara, Toshiaki J. (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1972. ELECTRICAL RESPONSES OF THE OLFACTORY BULB OF PACIFIC SALMON Oncorhynchus nerka AND Oncorhynchus kisutch. J. Fish. Res. Bd. Canada, 29(9): 1351-1355.

Olfactory bulbar electrical responses elicited by nasal infusion of food extracts, hand rinse, and several amino acid solutions were studied in sockeye (Oncorhynchus nerka) and coho (O. kisutch) salmon from several different sources. Comparison was also made in rainbow trout (Salmo gairdneri). Significant variations in the olfactory bulbar responses were observed among different species and even among the same species from different sources. The estimated lowest threshold concentration for L-serine was between 10^{-6} and 10^{-7} M in salmon. Olfactory responses of rainbow trout were always several times larger than those of salmon. Pretreatment of nasal cavity with 10^{-4} M solutions of $HgCl_2$ or $CuSO_4$ (27 or 16 mg/liter, respectively) for 10 sec completely blocked the olfactory responses in all fish species studied. The effect was reversible; the responses returned to their original level by rinsing. Exposure of fish to 0.1 mg/liter $HgCl_2$ for up to 3 days reduced the olfactory responses to 40-10% of those of normal fish. $CuSO_4$ was the more toxic. (Auth.)

15544. Sparks, Richard E., William T. Waller, and John Cairns, Jr. (Biol. Dept. and Center for Environ. Studies, Va. Polytech. Inst. and State Univ., Blacksburg, Virginia 24061). 1972. EFFECT OF SHELTERS ON THE RESISTANCE OF DOMINANT AND SUBMISSIVE BLUEGILLS (Lepomis macrochirus) TO A LETHAL CONCENTRATION OF ZINC. J. Fish. Res. Bd. Canada, 29(9): 1356-1358.

When pairs of bluegills (Lepomis macrochirus Rafinesque) were kept in bare, 10-gal compartments for 5 days, dominant-submissive relations developed, and the dominant fish survived a subsequent exposure to 32 mg/liter zinc longer than submissive fish. A flowerpot shelter in each compartment reduced the number of aggressive encounters between fish and removed the response difference. These results indicate that dominant-submissive relations may be a source of variability in the results of bioassays that use fish. (Authors)

15545. Ross, A. J., and Cathy A. Smith (Bur. of Sport Fish. & Wildl., Western Fish Disease Lab., Seattle, Washington 98115). 1972. EFFECT OF TWO IODOPHORS ON BACTERIAL AND FUNGAL FISH PATHOGENS. J. Fish. Res. Bd. Canada, 29(9): 1359-1361.

In in-vitro tests on nine species of bacteria and two species of fungi, the majority of strains tested did not survive a 5-min exposure to either Betadine or Wescodyne at a concentration of 25 ppm active ingredient. (Authors)

15546. Butler, David Gordon (Dept. of Zool., Univ. of Toronto, Toronto 181, Ontario, Canada). 1972. FAILURE TO OBSERVE CHANGES IN SELECTED METABOLITES FOLLOWING REMOVAL OF THE STANNIUS CORPUSCLES FROM THE FRESHWATER NORTH AMERICAN EEL, Anguilla rostrata. J. Fish. Res. Bd. Canada, 29(2): 1362-1364.

There were no measurable changes in plasma glucose, protein, or free fatty acid concentrations in the freshwater North American eel, Anguilla rostrata,

2 weeks after excision of the Stannius corpuscles. Liver glycogen concentrations were normal but muscle glycogen increased. Plasma Na decreased and K and Ca increased. These data indicate that secretions of the Stannius corpuscles are primarily concerned with ionoregulation. (Auth.)

15547. Jensen, A. L. (Div. of Environ. Research and Development, Tenn. Valley Authority, Chattanooga, Tennessee 37401). 1972. VARIATION IN RESULTS OF IDENTICAL BIOASSAYS OF MINNOWS SUBJECTED TO INSTANT TEMPERATURE INCREASE. Trans. Amer. Fish. Soc., 101(3): 403-407.

Variation in the results of five near-identical bioassays of fathead minnows subjected to instant increase in water temperature is examined. It is shown that median tolerance limits for an instant temperature increase can be estimated with precision, and levels of stress tolerable to more than 50% of the test fish can be estimated with somewhat lower precision. It is suggested that the standard deviation of the population tolerance frequency distribution can be of practical value in evaluating the effect of dilution on lethality of wastes. It is concluded that TL50 values should indeed be used in calculations of "safe" levels of water quality alteration when bioassays and so called "application factors" are employed in regulating disposal of lethal agents. (Auth.)

15548. Engel, Sandy, and John J. Magnuson (Lab. of Limnology, Univ. of Wis., Madison, Wisconsin). 1971. ECOLOGICAL INTERACTIONS BETWEEN COHO SALMON AND NATIVE FISHES IN A SMALL LAKE. Proc. 14th Conf. Great Lakes Res. 1971. 14-20. Internat. Assoc. Great Lakes Res.

Seasonal changes in vertical and horizontal distribution of cisco (Coregonus artedii), yellow perch (Perca flavescens) and introduced coho salmon (Oncorhynchus kisutch) were studied in Pallette Lake, Wisconsin using gill nets, fyke nets, electrofishing gear and echo sounders. Coho salmon were inshore in spring and fall, while cisco and yellow perch were more widely dispersed. In late summer, coho salmon and cisco occupied the metalimnion, whereas yellow perch were in warmer water. Insects, zooplankton and some fishes were eaten by coho salmon. Between April and October, coho salmon grew from 130 mm to 175 mm total length. These results suggest that young cisco and yellow perch were not available as food for these small coho salmon. (Authors)

15549. Thompson, Kenneth E., Allan K. Smith, and Jim E. Lauman (Environ. Management Section, Oregon State Game Comm., Portland Oregon). 1972. ENVIRONMENTAL INVESTIGATIONS. FISH AND WILDLIFE RESOURCES OF THE SOUTH COAST BASIN, OREGON, AND THEIR WATER REQUIREMENTS (REVISED). Oregon State Game Comm., 98 p., maps and tables.

Fish and wildlife resources of the South Coast Basin, their present status, distribution, limiting factors, value, and water requirements are discussed in this revised report. A report of the same title was published in December 1962. (From authors' introduction)

15550. Cairns, John, Jr., and Kenneth L. Dickson (Biol. Dept. and Center for Environ. Studies, Va. Polytech. Inst. and State Univ., Blacksburg, Virginia). 1972. AN ECOSYSTEMATIC STUDY OF THE SOUTH RIVER, VIRGINIA. VPI - WRRC-Bulletin 54, 104 p.

A biological survey of the fish, macroinvertebrates, algae, aquatic plants, protozoans, and bacteria was conducted on the South River, Virginia, in September 1970. The purpose of this survey was to measure the ecological condition of a system receiving agricultural, domestic, and industrial wastes. Eight sampling stations were located to determine the effects of various wastes on the biota of the South River. The fauna and flora at each station were examined to determine the diversity, density, and distribution of aquatic life in relation to physical and chemical water quality. Results of the study indicated that the discharge of domestic and industrial wastes in Waynesboro, Virginia: (1) exceeded the waste assimilative capacity of the river and caused the dissolved oxygen to be entirely depleted in certain reaches of the river at times of low flow and high temperature; (2)

enriched the system by adding nutrients such as carbon, phosphorus, and nitrogen, causing a definite shift in the composition of the flora; and (3) decreased the diversity of fish and macroinvertebrates and caused qualitative shifts in algae, higher plants, bacteria, and protozoans when compared to areas of the South River upstream of Waynesboro. The study indicated that biological recovery was not complete fourteen miles downstream of Waynesboro at Harriston, Virginia. (Authors)

15551. Johnston, James H. (International Pacific Salmon Fish. Comm., New Westminster, British Columbia, Canada). 1972. TOLERANCE OF JUVENILE SOCKEYE SALMON AND ZOOPLANKTON TO THE SELECTIVE SQUAWFISH TOXICANT 1, 1'-METHYLENEDI-2-NAPHTHOL. Progr. Fish-Cult., 34(3): 122-125.

The selective squawfish toxicant, 1, 1'-methylenedi-2-naphthol, (Squoxin) was tested for its toxicity to two races of juvenile sockeye salmon (Oncorhynchus nerka) at various stages of development, and to 10 species of zooplankton occurring in their diet. Static 96-hour bioassays were used to determine the highest concentration of Squoxin that was lethal to 0 percent of the sockeye (LC_0) and compared with the lowest concentration that was lethal to 100 percent (LC_{100}) of northern squawfish (Ptychocheilus oregonensis). The maximum LC_0 values for sockeye depended mainly on their stage of development, ranging from 0.09 to 0.10 ppm for alevins with yolk, to as high as 0.90 ppm for fry and fingerlings. Temperatures between 4.4° and 12.8°C had little influence on sockeye tolerance to Squoxin, but infection with the protozoan Costia reduced the LC_0 of fingerlings to 0.30 ppm. No differences were noted between the two races of sockeye studied. The minimum LC_{100} for northern squawfish varied with temperature, decreasing from 0.10 ppm at 4.4°C to 0.01 ppm at 12.8°C. Comparison of the two species indicated that newly hatched sockeye alevins would be subjected to lethal concentrations of Squoxin if squawfish eradication were attempted at temperatures of 4.4°C or less. After yolk absorption, sockeye could tolerate 3 to 90 times the Squoxin concentration lethal to squawfish. No mortalities occurred among the zooplankton tested in static bioassays for 7 days at 12.8°C, even at concentrations of Squoxin 10 times greater than needed to kill northern squawfish at the same temperature. (Auth.)

15552. Crawford, David L., and Duncan K. Law (Dept. of Food Sci. and Technol., Seafoods Lab., Oregon State Univ., Astoria, Oregon 97103). 1972. MINERAL COMPOSITION OF OREGON PELLET PRODUCTION FORMULATIONS. Progr. Fish-Cult., 34(3): 126-130.

The mineral composition of two Oregon pellet production formulations was determined. Four variations in the wet fish fraction composition for each formulation were included. Formulations were characterized as to proximate composition. Levels of total ash, P, K, Ca, Mg, Na, Al, Sr, Fe, B, Cu, Zn, and Mn were determined. The success of these formulations under hatchery conditions seems to support the supposition that essential minerals in required amounts are available from these formulations for good growth. (Authors)

15553. Moore, J. W. (Dept. of Zool, Coll. of Biol. Sci., Univ. of Guelph, Guelph, Ontario, Canada). 1972. PISCIVOROUS ACTIVITIES OF BROWN BULLHEADS IN LOCKHART POND, ONTARIO, CANADA. Progr. Fish-Cult., 34(3): 141-142.

Brown bullhead (Ictalurus nebulosus) greater than 21.5 cm, collected from Lockhart Pond, Ontario, Canada, fed mainly on fish (88% by volume). Pumpkinseeds (Lepomis gibbosus) comprised 55% of the total stomach volume, golden shiners (Notemigonus crysoleucas) 15%, and unidentified fish remains, 18%. Invertebrates, primarily larval Chironomidae, comprised the remaining 12%. High population density of bullheads, high incidence of encounter between bullheads and other fish species, and semidystrophic limnological conditions may be responsible for the unusual feeding habits. (Auth.)

15554. Coutant, Charles C. (Ecol. Sci. Div., Oak Ridge National Lab., Oak Ridge, Tennessee 37830). 1972. SUCCESSFUL COLD BRANDING OF NONSALMONIDS. Progr. Fish-Cult., 34(3): 131-132.

Bluegill and a few other hard-scaled fish species were successfully branded using liquid nitrogen as a coolant for a steel branding iron. The technique had heretofore been demonstrated only for salmonids. The technique is rapid, and the materials are inexpensive and readily available, providing there is convenient access to the coolant. (Auth.)

15555. Warner, Kendall (Maine Dept. of Inland Fish. and Game, Bangor, Maine). 1972. DEVELOPMENT OF A SPORT FISHERY FOR LANDLOCKED SALMON IN A RECLAIMED POND. Progr. Fish-Cult., 34(3): 133-140.

A 108-acre mesotrophic lake in northern Maine was reclaimed with toxaphene in 1961 to evaluate the possibility of establishing a landlocked salmon (Salmo salar) fishery, with rainbow smelts (Osmerus mordax) as forage in ponds previously considered too small for salmon management, and to evaluate factors affecting success. Initial salmon plantings failed to survive, but salmon were established by 1964, the 3rd year after reclamation. After five unsuccessful eyed-egg plantings were made, smelts became established by 1968. Of 13 species present prior to reclamation, 7 species were eradicated and 2 others are probably no longer present. Because heavy salmon stocking and late establishment of smelts threatened salmon growth rate, length and bag limits were liberalized in 1966, resulting in a heavy harvest of salmon. Salmon growth improved to above average by 1969-71, attributable to establishment of an abundant smelt population, reduced salmon stocking, and a moderate salmon harvest. A high quality salmon fishery is presently being provided under existing conditions. The advantages and constraints of salmon management in similar habitats are discussed. (Auth.)

15556. Amend, Donald F., and James W. Wood (Bur. of Sport Fish. & Wildl., Western Fish Disease Lab., Seattle, Washington 98115). 1972. SURVEY FOR INFECTIOUS HEMATOPOIETIC NECROSIS (IHN) VIRUS IN WASHINGTON SALMON. Progr. Fish-Cult., 34(3): 143-147.

Chinook (Oncorhynchus tshawytscha), coho (O. kisutch), and sockeye (O. nerka) salmon from 38 different stocks at 28 locations in or near the State of Washington were surveyed for infectious hematopoietic necrosis (IHN) virus. The virus was found only in sockeye salmon in the vicinity of Lake Washington. (Authors)

15557. Cline, Thomas F., and George Post (Colo. State Univ., Fort Collins, Colorado 80521). 1972. THERAPY FOR TROUT EGGS INFECTED WITH SAPROLEGNIA. Progr. Fish-Cult., 34(3): 148-151.

Eight antifungus compounds were tested for their efficacy in the control of Saprolegnia parasitica growth on artificial culture media and on incubating rainbow and brown trout eggs. The antifungus compounds used were malachite green, formalin, benzaldehyde, glutaraldehyde, Dowicide A, Karmex KL, Cutrine, and Dexon. In vitro tests conducted were by the standard cup-plate technique. In vivo tests were conducted by placing egg trays containing trout eggs into preparations of fungicide for 1-hour treatments, five consecutive days. Malachite green at 2 ppm and formalin at 150 ppm proved to be effective in controlling S. parasitica. Maximum concentrations used without effect in the in vivo study were benzaldehyde at 22.11 ppm, glutaraldehyde at 200 ppm, Dowicide A at 40 ppm, Karmex DL at 100 ppm, Cutrine at 8 ppm, and Dexon at 37.5 ppm. These compounds also appeared to be toxic to the trout eggs at relatively low concentrations. (Authors)

15558. Neill, William H., and Thomas C. Byles (Natl. Marine Fish. Service, Southwest Fish. Center, Honolulu, Hawaii 96812). 1972. AUTOMATIC PELLET DISPENSER FOR EXPERIMENTAL FEEDING OF FISHES. Progr. Fish-Cult., 34(3): p. 170.

An inexpensive, easily constructed fish-feeder is powered by an electric motor, which - through a mechanical-magnetic linkage - pushes pellets from a tubular magazine. (Authors)

15559. Rooney, Sally C., Franklin L. Roberts, and Roger P. Dexter (Dept. of Zool., Univ. of Maine, Orono, Maine 04473). 1972. HEMATOLOGICAL PARAMETERS OF IMMATURE ATLANTIC SALMON. Progr. Fish-Cult., 34(3): 152-155.

The blood of 102 Atlantic salmon (Salmo salar) aged 9 to 17 months, from Craig Brook National Fish Hatchery at Orland, Maine, was sampled from September 1967 into May 1968. About half were maintained under controlled periods of light and the other half kept under normal hatchery conditions. Blood cell counts, hemoglobin, and microhematocrit values were obtained. Differential counts were made from stained smears and the percentage of lymphocytes, monocytes, neutrophils, and thrombocytes tabulated. The hematological data exhibited wide variability throughout, and no parameter was clearly associated with parr-smolt transformation, with water temperature, or with photoperiod. (Authors)

15560. Windell, J. T., J. D. Hubbard, and D. L. Horak (Fish Physiology Lab., Biol. Dept., Univ. of Colo., Boulder, Colorado 80302). 1972. RATE OF GASTRIC EVACUATION IN RAINBOW TROUT FED THREE PELLETED DIETS. Progr. Fish-Cult., 34(3): 156-159.

The rate of gastric evacuation and digestion of experimental pelleted meals of identical formulation, except for lipid content, was investigated. Three groups of 20-24 hatchery-reared rainbow trout (Salmo gairdneri) averaging 29.7 g and 139.7 mm fork length consumed pelleted meals averaging 1.67% of the live body weight at a water temperature of 12°C. Diet A contained 6.9% water, 93% dry matter, and 6.5% lipid. Diet B contained 4.8% water, 95.2% dry matter, and 10.5% lipid. Diet C contained 4.9% water, 95% dry matter, and 14.5% lipid. Percentage decrease of dry matter from the stomach at sacrifice intervals of 6, 12, 18, and 24 hrs was 27.1, 48.7, 65.8, and 79.4 for diet A; 30.1, 51.2, 69.8, and 82.4 for diet B; 29.3, 49.1, 63.2, and 75.4 for diet C. Analysis of variance indicated no significant difference in gastric evacuation rate for fish consuming pelleted meals containing 6.5, 10.5 and 14.5% lipid content. Non-lipid food materials were evacuated from the stomach more rapidly than lipids. (Authors).

15561. Sylvester, J. R. (Coll. of Fisheries, Univ. of Wash., Seattle, Washington). 1972. EFFECT OF STARVATION TIME ON THE AMOUNT OF FOOD EATEN BY COHO SALMON. Progr. Fish-Cult., 34(3): 160-161.

Young coho salmon (Oncorhynchus kisutch) in aquariums were starved and then fed Oregon moist pellets to determine the effect of food deprivation time on the amount of food (pellets) eaten. There was no significant increase in the amount of food eaten with deprivation times up to 9 days. The results suggest that the length of time that fish are deprived of food is less important in influencing food consumption than temperature. (Auth.)

15562. Paperna, Ilan (Zool. Dept., Makerere Univ., Kampala, Uganda, Africa). 1972. INFECTION BY Ichthyophthirius multifiliis OF FISH IN UGANDA. Progr. Fish-Cult., 34(3): 162-164.

Infection by Ichthyophthirius multifiliis of fish in Uganda is reported for the first time from tropical Africa. Infection developed in fish from local fish ponds 7 days after being introduced into aquariums and one small outdoor pool. Many species of native fish were susceptible to infection while carp were fairly refractory. The possible sources of this infection are discussed. (Auth.)

15563. Cross, D. G. (Salmon and Freshwater Fish. Lab., Ministry of Agric., Fish. and Food, London SW1, England). 1972. A REVIEW OF METHODS TO CONTROL ICHTHYOPHTHIRIASIS. Progr. Fish-Cult., 34(3): 165-170.

The merits of methods for eradicating Ichthyophthirius multifiliis were assessed by making an extensive review of the literature. The choice of a method to control ichthyophthiriasis is between methylene blue, formalin, and chloramine-T. The best treatment seems to be chloramine-T providing the water hardness and pH value are known.

15564. Lackey, Robert T., and Donald W. Holmes (Div. of Forestry and Wildl. Sciences, Va. Polytechnic Inst. and State Univ., Blacksburg, Virginia 24061). 1972. EVALUATION OF TWO METHODS OF AERATION TO PREVENT WINTERKILL. Progr. Fish-Cult., 34(3): 175-178.

Continuous winter aeration and commencing aeration when dissolved oxygen reached low levels were compared in their effect on temperature, dissolved oxygen, and iron. Continuous winter aeration lowered water temperatures, eliminated thermal gradients, maintained dissolved oxygen at high levels, and eliminated iron buildups. Commencing aeration when dissolved oxygen was low had little effect on water temperature, but caused an immediate lowering of dissolved oxygen and an increase in iron. Dissolved oxygen slowly increased in concentration after this initial decline. Commencing aeration when dissolved oxygen is low, to prevent winterkill, should be done cautiously. (Authors)

15565. Plosila, Daniel S., Walter T. Keller, and Thomas J. McCartney (N. Y. State Dept. of Environ. Conservation, Ray Brook, New York 12977). 1972. EFFECTS OF SPERM STORAGE AND DILUTION ON FERTILIZATION OF BROOK TROUT EGGS. Progr. Fish-Cult., 34(3): 179-181.

Both dilution (water) and storage (time) of sperm had significant effects on fertilization of brook trout eggs; dilution almost doubled the fertility of both fresh and stored sperm while storage reduced fertilization by about 50%. It is recommended that brook trout sperm be stored at about 2°C for not longer than 24 hours before use. Proportionally greater quantities of stored milt should be used in lieu of fresh milt. The volume of dilution water to milt should be about 1:1 particularly when using small quantities of milt (0.5 ml per female) in the dry method of fertilization.

15566. Sykora, Jan L., Edward J. Smith, and Milan Synak (Grad. School of Public Health, Univ. of Pittsburgh, Pittsburgh, Pennsylvania 15213). 1972. AN INEXPENSIVE FISH EGG INCUBATOR. Progr. Fish-Cult., 34(3): 183-184.

A hydraulically powered device is described which was used for experimental incubation of fathead minnow (Pimephales promelas) eggs in different concentrations of ferric hydroxide. This incubator is easy to construct, low in cost, trouble-free in operation, and not dependent upon electric power.

15567. Clayden, A. D. (Fisheries Lab., Lowestoft, England). 1972. SIMULATION OF THE CHANGES IN ABUNDANCE OF THE COD (Gadus morhua L.) AND THE DISTRIBUTION OF FISHING IN THE NORTH ATLANTIC. Ministry of Agric., Fish. and Food. Fishery Investigations Series II, 27(1): 58 p.

This paper attempts to treat the various cod stocks of the North Atlantic in an integrated manner. Individual population models of the Beverton and Holt type are first produced, predicting the effect of different levels of fishing effort on the separate stocks, e.g. the numbers of cod of various ages likely to be caught, the number left in the stock and the weight of the total expected catch, in metric tons. National catch and fishing effort statistics on these stocks since 1946 are used to derive estimates of the total national and international catch (in metric tons) and fishing effort (in ton-hours fishing) associated with cod in the north Atlantic. A computer program is described which simulates the changes in abundance of these cod stocks for each year since 1946. Estimates of the size and composition of the individual stocks in 1946 are used as a starting point, and total national fishing efforts in each month of each year are distributed between the stocks by the program on the basis of the expected catch from each stock by a given nation. The international fishing effort so distributed then interacts with the resources to generate changes in the stocks and catches from them. Depending largely on the magnitude of recruitment and the amount of fishing applied, each stock is either increasing in numbers, maintaining its abundance, or decreasing in numbers. The more abundant a stock is, the more likely it is to attract fishing effort, which in its turn helps to make the stock less attractive. The simulation shows that the changes in abundance of the cod stocks in the northeast Atlantic since 1946 can be explained satisfactorily in this manner. The simulation is less accurate for the northwest Atlantic stocks, due in part to insufficient data. A realistic example is

given to demonstrate the use of the model in predicting the effect of future changes in fishing effort on the north Atlantic stocks. (Auth.)

15568. Peters, Nicolaus, Gabriele Peters, and Gisela Bresching (Inst. für Hydrobiol. und Fischereiwiss. der Univ. Hamburg, Hamburg, Germany). 1972. REDIFFERENTIATION AND GROWTH INHIBITION IN EPIDERMAL TUMORS OF THE EUROPEAN EEL UNDER THE INFLUENCE OF QUININE SULFATE (Redifferenzierung und Wachstumshemmung von epidermalen Tumoren des europäischen Aals unter Einwirkung von Chininsulfat). Arch. FischWiss., 23(1): 47-63. In German with English summary.

In this study, growth of the epidermal papilloma of the European eel in the presence of quinine sulfate is shown to be reduced, or to cease completely, depending on drug concentration in the ambient medium. During several weeks of treatment there occurs a redifferentiation of the tumor tissue with new formation of mucous and club cells originating from indifferent tumor cells. Simultaneously, tight contact between cells is reestablished by the cell's outer membrane being restored, as can be seen in the electron microscope. The tissue regains the structure of normal epidermis. Reorganization of the tumor tissue is the result of reversion of the individual tumor cell. This is derived from the following observations: 1. Redifferentiation is accompanied by inhibition of tumor growth; and 2. The reversed cell preserves, at least for some time, certain "neoplastic" characters such as number and shape of mitochondria. This demonstrates the descent of the redifferentiated cell from a formerly neoplastic cell. Thus, cell transformation may be accepted as generally reversible, although spontaneous reversions are only seldom observed. Starting from the phenomenon of tumor progression as well as from the reversibility of neoplastic growth it is discussed, that the concept that tumor genesis is the direct result of mutational change, does not meet the apparent facts. (Authors summ.)

15569. Bock, K. J., and H. Mann (Inst. für Küsten- und Binnenfischerei der Bundesforschungsanstalt für Fischerei, Hamburg, Germany). 1972. TOXICITY OF OIL-SPILL REMOVERS (Toxikologische Untersuchung von Emulgatoren für die Bekämpfung von Ölverschmutzungen). Arch. FischWiss., 23(1): 64-67. In German with English summary.

Fourteen different samples of special oil dispersing products were examined with regard to the toxicity they cause in organisms of fresh water, brackish water and sea water. From the experiments resulted that concerning their toxic effect a great number of the compounds are to be grouped into class III of the classification according to Hellmann and Knöpp, which means that up to the highest examined concentration of 200 mg/l no toxicity exists. A specially low degree of toxicity was found in compound VIII. These results have shown that products of the groups fatty-acid-polyglycolic-ester are of practical importance. (Authors summ.)

15570. Lahav, M., and S. Sarig (Lab. for Fish Diseases, Nir David, Israel). 1972. CONTROL OF UNICELLULAR PARASITES USING FORMALIN. Bamidgeh, 24(1): 3-11.

It is possible to eradicate the unicellular parasites Chilodonella, Costia and Trichodina in 30-40 ppm formalin applied to the entire fish population within the pond. Fishes were parasite-free within 6 hours after the beginning of the treatment. In a 24-hours exposure to formalin at concentrations 3-4 times that recommended for parasite eradication in the pond, 70% of the carp were affected. Carp, tilapia and mullet were identically sensitive to formalin. The toxicity of formalin to carp increased at higher temperatures. The water salinity has no effect on the degree of formalin toxicity. The oxygen deficiency due to formalin treatment developing during the night can be prevented by applying formalin early in the morning, so that fresh water can be added 6-8 hours afterwards, before nightfall. (Authors summ.)

15571. Crowley, Gerald J. (Bur. of Sport Fish. & Wildl., Sierra Nevada Aquatic Res. Lab., Bishop, California 93514). 1972. A BATTERY POWERED MAGNETIC STIRRER FOR FIELD USE. Progr. Fish-Cult., 34(3): p. 159.

15572. Anthony, A., E. L. Cooper, R. B. Mitchell, W. H. Neff, and C. D. Therrien (Dept. of Biol., Pa. State Univ., University Park, Pennsylvania). 1972. HISTOCHEMICAL AND CYTOPHOTOMETRIC ASSAY OF ACID STRESS IN FRESH-WATER FISH. Environ. Protection Agency, Water Pollution Control Research Series 18050 DXJ, May 1971, 113 p.; Selected Water Resources Abstracts, 5(15): p. 60, 1972.

Cytophotometry as a bioassay approach enables detection of fish tissue changes as water pollution indicators. Data on hemal, endoctrine, and excretory tissue parameters are especially significant. Feasibility of using histochemical and histopathological changes in brook trout, longnose dace and fathead minnows as bioindicators of acid pollution was investigated. A gravity flow diluter system was used in laboratory studies and net traps in field studies during sublethal exposures of 4-5 and 28-30 days. Histochemical and cytophotometric analyses were made of gills, Stannius corpuscle, blood, spleen, kidney and liver. Acid toxicant action is primarily gill damage resulting in impaired respiratory, excretory and liver functions. Short term indices of acid stress include colloidal iron and PAS staining of gills and renal Stannius corpuscles. Prolonged acid exposure is indicated by decreased azure B-RNA staining of liver cells, assessing the extent of liver impairment and reflecting a reduced tolerance of fish to other toxicants. Sublethal levels of acidity are not cumulative. Levels of about pH 5.0 are considered hazardous, proving toxic to breeding fish having increased oxygen needs, and reducing the liver's ability to detoxify noxious substances present in acid polluted waters.

15573. Olson, P. R. (Coll. of Fisheries, Washington Univ., Seattle, Washington). 1971. ACCUMULATION OF CALCIUM-45 IN DEVELOPING COHO SALMON EGGS AND FRY REARED IN VARYING CONCENTRATIONS OF STABLE CALCIUM. Available from NTIS as RLO-2225-T-7-4, $3.00 in paper copy, $0.95 in microfiche. Report Nos. CONF-710501-29, TID-4500 (57th Ed.), May 10-12, 1971, 30 p.; Selected Water Resources Abstracts, 5(15): p. 66, 1972.

Coho salmon eggs were fertilized and reared in tap water with calcium concentrations of 6 to 76 mg/liter to study the effect of this cation on embryo development and hatching. The eggs were prepared and incubated in sixteen 18-liter cylindrical pyrex jars, one containing flowing hatchery water and five sets of jars in triplicate for the various calcium concentrations. Calcium-45 was added to twelve jars; stable calcium (CaCl) was added to the remaining jars. The results showed that fertility of the eggs was improved in calcium concentrations above 6 ppm. Eggs in calcium concentrations of 76 ppm hatched two days earlier than those in solutions containing 6 ppm. The stable calcium concentration in all lots was similar, regardless of calcium concentrations in the solutions. A significant amount of calcium-45 entered the eggs during the water-hardening period, but only a slight amount was taken up during the 57 days to hatching. During the two week period after hatching, a tenfold increase in the uptake of calcium-45 was noted, which was associated with ossification. Discussion is also included on the concentration of stable calcium, magnesium, sodium, and potassium in the fry of different species of fish.

15574. Deacon, James E., and W. Glen Bradley (Dept. of Biol. Sci., Univ. of Nevada, Las Vegas, Las Vegas, Nevada 89109). 1972. ECOLOGICAL DISTRIBUTION OF FISHES OF MOAPA (MUDDY) RIVER IN CLARK COUNTY, NEVADA. Trans. Amer. Fish. Soc., 101(3): 408-419.

Fish collections were made at nine stations along the Moapa River of southern Nevada. Four native species are ecologically separated into headwater and middle-stream types. The headwater fishes are ecologically segregated into one pond species (Crenichthys baileyi) and one stream species (Moapa coriacea). The apparent temperature preference for both species is near 29.5C. Temperature range for Crenichthys is 27-32 C and for Moapa 19.5-32 C. Both Gila robusta and Rhinichthys osculus are most abundant in the turbid middle portion of the stream in undisturbed, deep riffle habitats. A fifth native species, Plagopterus argentissimus, is extremely rare or of accidental occurrence. The unsaturated Moapa River environment has been easily colonized by exotic or non-native species,

most recently and most successfully by Poecilia mexicana. An additional species, Gambusia affinis, is widespread and abundant throughout much of the stream. Cyprinus carpio, Notropis lutrensis, Pimephales promelas, Ictalurus melas, Ictalurus punctatus, Micropterus salmoides, and Lepomis cyanellus occur in the lower and/or middle sections of the stream where populations of Gila and Rhinichthys may have been more abundant prior to these introductions. Populations of Moapa and Crenichthys in the headwaters also appear to have declined following the introduction of Poecilia. Populations of all native species have apparently recovered somewhat from a low in 1963-64. (Authors)

15575. Macek, Kenneth J., David F. Walsh, James W. Hogan, and Delmar D. Holz (Fish-Pesticide Res. Lab., U. S. Bur. of Sport Fish. & Wildl., Columbia, Missouri). 1972. TOXICITY OF THE INSECTICIDE DURSBAN TO FISH AND AQUATIC INVERTEBRATES IN PONDS. Trans. Amer. Fish. Soc., 101(3): 420-427.

Bluegills (Lepomis macrochirus Rafinesque) and largemouth bass (Micropterus salmoides Lacépède) were exposed to two applications of Dursban, an organophosphorus insecticide, at the recommended rates for mosquito control of 0.05 or 0.01 lb of active ingredient/A in experimental 0.1 acre ponds. Residues of Dursban in water 1 day after the applications ranged from 2.39 parts per billion (ppb) in the highest treatment to 0.97 ppb in the low treatment. Cumulative mortality in the untreated ponds during 63 days of observation was approximately 1% of the total population of each species of fish. Cumulative mortality of fishes during the same period in ponds treated at 0.01 lb/A was 3% for bluegills and 10% for bass, whereas the corresponding mortalities for the high application rate (0.05 lb/A) were 55% for bluegills and 46% for bass. Uptake of Dursban by fishes produced maximum residue values of 3.82 parts per million (ppm) in bluegills and 2.55 ppm in bass within 1 to 3 days after application of the insecticide at 0.05 lb/A. These residues decreased greatly within 2 weeks to less than 0.4 ppm and were undetectable after 4 weeks. Both species of fish taken from the ponds treated at 0.05 lb/A exhibited more than 80% inhibition of brain acetylcholinesterase activity as compared to fish from untreated ponds; fishes from these ponds had not recovered normal acetylcholinesterase activity 28 days after application of the insecticide. Histological examination of tissues from bluegills and largemouth bass exposed to Dursban did not show conclusive evidence for pesticide-induced pathology. The high treatment reduced the total number of insects colonizing plate samplers by three-fourths, eliminated caddisflies, and severely reduced mayfly populations. We believe that the results of this investigation confirm the inadvisability, as suggested on product labels,of using Dursban at the current recommended rates of application for mosquito control in habitats where valuable fishery resources are to be protected. (Authors)

15576. Bonham, Kelshaw, and Lauren R. Donaldson (Coll. of Fish., Univ. of Wash., Seattle, Washington 98195). 1972. SEX RATIOS AND RETARDATION OF GONADAL DEVELOPMENT IN CHRONICALLY GAMMA-IRRADIATED CHINOOK SALMON SMOLTS. Trans. Amer. Fish. Soc., 101(3): 428-434.

The gonads of 4,405 premigratory smolts from eight year classes of chinook salmon, Oncorhynchus tshawytscha (Walbaum), were inspected to determine sex. Nearly half of the smolts of seven of the year classes had been irradiated for their first 80 days of life by exposure to the gamma rays of cobalt-60 at rates that increased almost exponentially from 0.5 F/day the first year to a maximum of 50 R/day the last year. Sex ratios were unaffected by 5 R/day or less, but at 10 or more R/day gonadal development was retarded. (Authors)

15577. Colby, Peter J., and George N. Washburn (U. S. Bur. of Sport Fisheries and Wildlife, Great Lakes Fishery Lab., Ann Arbor, Michigan 48107). 1972. FEEDING BEHAVIOR OF LAKE WHITEFISH AND LAKE HERRING IN TORCH LAKE, MICHIGAN. Progr. Fish-Cult., 34(3): p. 151.

15578. Burton, Dennis T., Eric L. Morgan, and John Cairns, Jr. (Dept. of Biol. and Center for Environ. Studies, Va. Polytech. Inst. and State Univ., Blacksburg, Virginia 24061). 1972. MORTALITY CURVES OF BLUEGILLS (Lepomis macrochirus Rafinesque) SIMULTANEOUSLY EXPOSED TO TEMPERATURE AND ZINC STRESS. Trans. Amer. Fish. Soc., 101(3): 435-441.

Bluegills were exposed to a temperature-zinc interaction consisting of five temperature regimes and four concentrations of zinc which were 1.0, 5.6, 10.0 and 32.0 mg Zn^{++}/l. All of the above concentrations of zinc and a control were tested on five groups of fish which had been acclimated to (1) 20 ± 1 C, (2) 30 ± 1 C and fish which had been acclimated to 20 ± 1 C and were exposed to temperature increases at the following rates: (3) 1 C/24 hours, (4) 1 C/1 hour and (5) 1.5 C/10 minutes until a maximum of 30 C was reached. This study showed that a rise in temperature could reduce the survival time of bluegills exposed to lethal and sublethal concentrations of zinc. Reductions in survival time were a function of the rates at which the temperature was increased. For example, bluegills acclimated to 20 and 30 and then exposed to a lethal concentration of zinc (32 mg Zn^{++}/l) at each temperature died 2.6 times faster at 30 C than at 20 C. Fish acclimated to 20 C and exposed to a temperature increase of 1.5 C/10 minutes died 4.8 times faster than fish maintained at 20 C. A sublethal zinc concentration (5.6 mg Zn^{++}/l) produced no mortalities in 20 C acclimated bluegills in 96 hours but was toxic to fish when the temperature was increased from 20 to 30 C at a rate of 1.5 C/10 minutes. (Authors)

15579. Turner, Jerry L., and Harold K. Chadwick (Anadromous Fisheries Branch, Calif. Dept. of Fish and Game, Stockton, California 95205). 1972. DISTRIBUTION AND ABUNDANCE OF YOUNG-OF-THE-YEAR STRIPED BASS, Morone saxatilis, IN RELATION TO RIVER FLOW IN THE SACRAMENTO-SAN JOAQUIN ESTUARY. Trans. Amer. Fish. Soc., 101(3): 442-452.

Annual distribution and abundance of young-of-the-year striped bass were measured from 1959 to 1970 in the Sacramento-San Joaquin estuary. Annual abundance of young bass in late summer was closely related to the amount of river flow in June-July into the estuary (r = 0.89). Highly significant correlations existed between striped bass abundance and salinity and water diverted from the estuary, both of which were mutually related to the amount of river flow. Six mechanisms which may control these relationships are discussed. Annual striped bass distribution in the estuary was also related to river flow (r = -.93) and salinity (r = 0.88) with bass being farther upstream in years of low runoff and high salinity. (Authors)

15580. Koo, Ted S. Y., and John S. Wilson (Chesapeake Biol. Lab., Natural Resources Inst., Univ. of Maryland, Solomons, Maryland 20688). 1972. SONIC TRACKING STRIPED BASS IN THE CHESAPEAKE AND DELAWARE CANAL. Trans. Amer. Fish. Soc., 101(3): 453-462.

To observe striped bass, Morone saxatilis (Walbaum), migration through the Chesapeake and Delaware Canal, we placed ultrasonic transmitters in the stomachs of five adult bass and traced their movements for as long as 4 days and nights in the spring of 1971. Three bass were pre-spawning and 2 post-spawning. The tags were Smith-Root SR-69B; the receiving equipment consisted of an SR-70H hydrophone and a TA-60 sonic receiver. Tagged bass ranged from 470 to 908 mm in fork length. We experienced no shedding of tags, nor difficulty with sound transmission and reception. No bass tracked was travelling at all times; on the contrary, there were long rest periods between moves during both day and night. Fish were more active during the night than during the day. Pre-spawning adults tended to be moving more constantly than post-spawning fish which tended to linger more within the canal. Lost signal could be picked up again fairly easily. One tagged fish was refound after a 24-hour interval. (Authors)

15581. Ervin, Joseph L., and Terry A. Haines (Dept. of Fish. and Wildl., Mich. State Univ., East Lansing, Michigan 48823). 1972. USING LIGHT TO COLLECT AND SEPARATE ZOOPLANKTON. Progr. Fish-Cult., 34(3):171-174.

15582. Gard, Richard, and Donald W. Seegrist (School of Forestry and Conservation, Univ. of Calif., Berkeley, California 94720). 1972. ABUNDANCE AND HARVEST OF TROUT IN SAGEHEN CREEK, CALIFORNIA. Trans. Amer. Fish. Soc., 101(3): 463-477.

Between 1952 and 1961 standing crops of brook (Salvelinus fontinalis), rainbow (Salmo gairdneri), and brown (Salmo trutta) trout were determined in August for a 5.7 mile section of Sagehen Creek in east-central California. In 1953 a creel census was initiated which continued through 1961. The purpose of the study was to determine if a moderately productive wild trout stream could support a substantial angler harvest over an extended period without augmentation with hatchery-reared trout. The 10-year average standing crop of all trout was 1,578 (37 pounds) per acre. Standing crops declined somewhat during the study period, largely due to habitat deterioration rather than to fishing. Floods and abandonment of beaver impoundments were the primary adverse influences on trout habitat. Catch did not decline significantly over the period. Fishermen annually removed 23-47% (average, 33%) of all trout over 99 mm in length, but recruitment replaced the loss. Although the natural fishery has proven to be viable, the trout population is not characterized by many large fish. We recommend an experimental management program aimed at (1) restoring some of the brown trout habitat by construction of low dams similar to the beaver dams that formerly were so productive, and (2) increasing the number of larger trout in the stream by regulation of the take. If each large trout is subject to multiple capture and release, additional high-quality sport would be provided. Future studies could evaluate the effect on the fishery of these changes in management. (Authors)

15583. Seegrist, Donald W., and Richard Gard (School of Forestry and Conservation, Univ. of Calif., Berkeley, California 94720). 1972. EFFECTS OF FLOODS ON TROUT IN SAGEHEN CREEK, CALIFORNIA. Trans. Amer. Fish. Soc., 101(3): 478-482.

Effects of winter and spring floods on rainbow (Salmo gairdneri) and brook (Salvelinus fontinalis) trout were evaluated over a 10-year period in Sagehen Creek, California. Winter floods decimated developing eggs of fall-spawning brook trout. Because of reduced competition by young brook trout, survival of spring-spawned rainbow fry increased in years following winter floods. Conversely, spring floods destroyed rainbow eggs, thereby enhancing survival of young brook trout. Floods changed the species composition markedly and these changes endured for several years. Adult trout were adversely affected by the worst flood studied, but were unaffected by other floods of lesser magnitude. Effects of floods were not nearly as pronounced or predictable on adult trout as they were on young trout. (Authors)

15584. Dennison, Samuel G., and Ross V. Bulkley (Iowa Coop. Fish. Unit, Iowa State Univ., Ames, Iowa 50010). 1972. REPRODUCTIVE POTENTIAL OF THE BLACK BULLHEAD, Ictalurus melas, IN CLEAR LAKE, IOWA. Trans. Amer. Fish. Soc., 101(3): 483-487.

Gonadal development, time of spawning, and fecundity of black bullheads were examined in 1969 and 1970 for insight into the reproductive potential of this species in a warm-water lake. Maturity indexes peaked around 1 June in both years. Spawning was evidently triggered by rising water temperatures during June. Fecundity seemed unrelated to body length because ovaries of fish of similar length varied more than 100% in number of mature ova present. (Authors)

15585. Dias, Robert K., James K. Dias, and William D. Anderson, Jr. (Marine Resources Div., S. C. Wildl. Resources Dept., Charleston, South Carolina 29412). 1972. RELATIONSHIPS OF LENGTHS (STANDARD, FORK, AND TOTAL) AND LENGTHS TO WEIGHT IN THE RED PORGY, Pagrus sedecim (PERCIFORMES, SPARIDAE), CAUGHT OFF SOUTH CAROLINA. Trans. Amer. Fish. Soc., 101(3): 503-506.

Data on standard length and weight frequencies and the statistics of length to length and lengths to weight regressions are presented for specimens of Pagrus sedecim collected off the coast of South Carolina in 1970. (Authors)

15586. Bouck, Gerald R. (Western Fish Toxicology Sta. (NWQL), Environ. Protection Agency, 1350 S.E. Goodnight Ave., Corvallis, Oregon 97330). 1972. EFFECTS OF DIURNAL HYPOXIA ON ELECTROPHORETIC PROTEIN FRACTIONS AND OTHER HEALTH PARAMETERS OF ROCK BASS (Ambloplites rupestris). Trans. Amer. Fish. Soc., 101(3): 488-493.

Studies are presented describing some physiological responses of rock bass (Ambloplites rupestris) to diurnal hypoxia. Diurnal hypoxia altered the levels of hemoglobin, hematocrit and total plasma protein, gill ventilation rates, and growth. Electrophoretic analyses established that plasma, myogen, and hemogen fractions also were altered significantly. However, the biological significance of changes in protein composition remains uncertain. (Auth.)

15587. Utter, Fred M., and Harold O. Hodgins (NMFS, Northwest Fisheries Center, 2725 Montlake Blvd. East, Seattle, Washington 98102). 1972. BIOCHEMICAL GENETIC VARIATION AT SIX LOCI IN FOUR STOCKS OF RAINBOW TROUT. Trans. Amer. Fish. Soc., 101(3): 494-502.

Biochemical variants of the enzymes alpha glycerophosphate dehydrogenase (AGPD), lactate dehydrogenase (LDH), malate dehydrogenase (MDH), tetrazolium oxidase (TO), and phosphoglucomutase (PGM) and of the serum protein transferrin (Tfn) were identified in four stocks of rainbow trout (Salmo gairdneri). Various lines of evidence indicated that each polymorphic system reflected genetic variation at discrete loci. Each stock had a distinct genetic profile based on the frequency of different biochemical variants. The findings have considerable potential for application including: (1) characterization and identification of stocks; (2) indicators of inbreeding in hatchery and wild populations; (3) studies of physiological differences of genetically related forms of a particular enzyme and of environmental factors influencing retention of these variant genes in different populations; (4) use as genetic markers in seeking linkages; and (5) studies of ecological and evolutionary relations among rainbow trout and other closely related salmonid species. (Authors)

15588. Gallepp, George W., and John J. Magnuson (Dept. of Zool., Lab. of Limnology, Univ. of Wis., Madison, Wisconsin 53706). 1972. EFFECTS OF NEGATIVE BUOYANCY ON THE BEHAVIOR OF THE BLUEGILL, Lepomis macrochirus Rafinesque. Trans. Amer. Fish. Soc., 101(3): 507-512.

The influence of induced negative buoyancy on depth distribution, pectoral fin movements, and gas secretion was observed for bluegills of ca. 130 g weight. Negative buoyancy was induced by inserting small weights (excess mass = 2.76 g) into the fish's stomach. Sham handled and minimally handled fish were compared with weighted fish. Initially weighted fish sank to the bottom and in a 160-cm deep tank, most remained there for 4 hr; in a 45-cm deep aquarium, most fish left the bottom in 1.5 hr. Pectoral fin movements (median number/min) of fish hovering in midwater increased from 48 to 104 when weights were added. As fish regained neutral buoyancy by gas secretion, time spent on the bottom and pectoral fin movements returned to pretreatment levels. Gas was secreted to the gas bladder of weighted fish at a maximum rate of approximately 0.1 ml/kg of fish/min at 21 C, such that fish in 30-cm deep aquaria could regain neutral buoyancy within 300 min after weight injection. The influence of induced negative buoyancy on other fishes, and problems of using a negatively buoyant telemetry device in field studies of fish behavior are discussed. (Authors)

15589. Carlson, Anthony R., and John G. Hale (U. S. Environ. Protection Agency, NWQL, Water Quality Office, Region V, 6201 Congdon Blvd., Duluth, Minnesota 55804). 1972. SUCCESSFUL SPAWNING OF LARGEMOUTH BASS Micropterus salmoides (Lacépède) UNDER LABORATORY CONDITIONS. Trans. Amer. Fish. Soc., 101(3): 539-542.

Information on the successful spawning of largemouth bass in the laboratory is needed to develop a culturing method that can be adapted to long-term bioassay systems. The objective of this study was to induce largemouth bass spawning in the laboratory by providing suitable environmental conditions along with materials used successfully as spawning substrates in pond culture of this species. Test

fish fed Oregon Moist pellets spawned and produced viable eggs, but weighed less than fish fed on an equal amount by weight of live food. Spanish moss substrates produced the most successful spawns in terms of egg hatchability (70-90%) indicating its suitability as a spawning substrate for largemouth bass in long-term bioassays. Spawning occurred at flow rates of 4 and 12 liters per minute which meet the requirements for continuous flow bioassasy (Standard Methods of the American Public Health Association et al., 1971).

15590. Sikora, Walter B., Richard W. Heard, and Michael D. Dahlberg (Univ. of Georgia Marine Inst., Sapelo Island, Georgia 31327). 1972. THE OCCURRENCE AND FOOD HABITS OF TWO SPECIES OF HAKE, Urophycis regius AND U. floridanus IN GEORGIA ESTUARIES. Trans. Amer. Fish. Soc., 101(3): 513-525.

From 1967 to 1970 a total of 2,683 spotted hake, Urophycis regius and 470 southern hake, U. floridanus were collected and found to exhibit migratory patterns in Georgia similar to northern and Gulf populations of these fish. The food habits of inshore juvenile populations of these two species of hake collected from coastal salt marsh-estuarine areas near Sapelo Island, Georgia were examined. The 341 spotted hake and 192 southern hake examined contained identifiable food items. These were analyzed for the numbers of individual food organisms, percent frequency of occurrence, and percent biomass. The most important group in occurrence and biomass was the Crustacea with Macrura and Natantia most important gravimetrically, Amphipoda and Mysidacea most frequently occurring. These data when combined with the habits of the food organisms established these two hakes as species which use the estuary as "nursery grounds." (Authors)

15591. Marking, Leif L. (Fish Control Lab., P. O. Box 862, LaCrosse, Wisconsin 54601). 1972. SALICYLANILIDE I, AN EFFECTIVE NON-PERSISTENT CANDIDATE PISCICIDE. Trans. Amer. Fish. Soc., 101(3): 526-533.

Salicylanilide I (2', 5-dichloro-3-*tert*-butyl-6-methyl-4'-nitrosalicylanilide) was tested for its toxicity to 20 species of freshwater fish in laboratory bioassays and to 15 species in outdoor pool bioassays. It is extremely toxic to all species of fish tested, and the 96-hour LC50's range from 0.3 to 8.6 ppb (parts per billion) in standard tests. Ictalurids are about as sensitive as salmonids to Salicylanilide I. Cyprinids are equally or more sensitive to the chemical than some centrarchids. Salicylanilide I effectively kills fish at similar concentrations in soft and hard water, in cold or warm water, and in acid or alkaline water. In outdoor pools, Salicylanilide I killed all fish of 15 species at concentrations of 40 and 60 ppb and all fish of 12 species at a concentration of 20 ppb. The chemical detoxifies in water, but detoxification appears to be inhibited by colder temperatures. The broad spectrum piscicidal activity of Salicylanilide I in waters of various qualities and temperatures offers advantages over presently used fish toxicants. (Auth.)

15592. Coppage, David L. (Environ. Protection Agency, Gulf Breeze Lab., Sabine Island, Gulf Breeze, Florida 32561). 1972. ORGANOPHOSPHATE PESTICIDES: SPECIFIC LEVEL OF BRAIN AChE INHIBITION RELATED TO DEATH IN SHEEPSHEAD MINNOWS. Trans. Amer. Fish. Soc., 101(3): 534-536.

Inhibition of brain acetylcholinesterase (AChE) in sheepshead minnows, Cyprinodon variegatus, by static exposures to acute doses of Guthion, phorate, and parathion that killed 40 to 60% of the fish in 2, 24, 48, and 72 hours indicates that effect is a function of pesticide concentration and length of exposure. Inhibition to less than 87% of normal activity is necessary to indicate exposure. The greatest inhibition caused by sublethal exposures is not as great as that caused by lethal exposures. Death occurs when AChE activity falls below 17.7% of normal, and levels below this value indicate impending death from exposure even when pesticide concentration and exposure times are unknown. In single tests, phosphamidon, Cygon, malathion, EPN, Dursban, DDVP, Diazinon, Dibrom, and methyl parathion caused inhibition to less than 17.7% of normal activity when 40 to 60% of the fish were killed. These data indicate that brain AChE levels, when properly assayed, are dependable indicators of exposure and death. (Auth.)

15593. Bulkley, Ross V. (Iowa Coop. Fish. Unit, Ames, Iowa 50010). 1972. DIETHYLSTILBESTROL IN CATFISH FEED. Trans. Amer. Fish. Soc., 101(3): 537-539.

Diethylstilbestrol evidently has a negative effect on protein synthesis in immature catfish even when they are fed levels less than one-fourth those given cattle. Renal hypertrophy and appetite suppression increased with dosage. At the highest dosage tested, weight loss, gross edema and urine retention occurred. Thus, DES seems to hold little promise as a feed additive for fingerling channel catfish. (From auth. conclusions)

15594. Youngs, William D. (Dept. of Natural Resources, N. Y. State Coll. of Agric. and Life Sciences, Cornell Univ., Ithaca, New York). 1972. ESTIMATION OF NATURAL AND FISHING MORTALITY RATES FROM TAG RECAPTURES. Trans. Amer. Fish. Soc., 101(3): 542-545.

A method is developed for determination of mortality rates using tag returns. Exploitation as determined by tag returns is plotted against survival for the same year. The intercept value of the resulting linear regression provides an estimate of survival in the event of no fishing. Knowing this value allows one to compute annual natural and fishing mortality rates.

15595. Goodyear, C. Phillip, and Claude E. Boyd (Savannah River Ecology Lab., P. O. Drawer E, Aiken, South Carolina 29801). 1972. ELEMENTAL COMPOSITION OF LARGEMOUTH BASS (Micropterus salmoides). Trans. Amer. Fish. Soc., 101(3): 545-547.

The elemental composition of largemouth bass (Micropterus salmoides) from five sites was determined. Little variation in individual fish was observed and the data appear useful for biogeochemical applications.

15596. Leggett, William C. (Dept. of Biol., McGill Univ., Montreal 101, Quebec, Canada). 1972. WEIGHT LOSS IN AMERICAN SHAD (Alosa sapidissima, Wilson) DURING THE FRESHWATER MIGRATION. Trans. Amer. Fish. Soc., 101(3): 549-552.

Connecticut River shad experience mean somatic weight losses ranging from 44 to 51% during the freshwater migration. Weight loss was size dependent in males, the larger fish experiencing higher average and mean daily somatic weight losses. If allowance is made for the delayed entry of females into fresh water, it appears that females experience greater mean daily somatic weight losses than males. Weight loss resulting from the spawning migration severely weakens the shad. These weight losses may have an important effect on adult survival. (Auth.)

15597. Adams, William J., David J. Behmer, and Warren O. Weingarten (Lake Superior State Coll., Sault Ste. Marie, Michigan 49783). 1972. RECOVERY OF SHOCKED COMMON SHINER, Notropis cornutus, RELATED TO ELECTRIC ENERGY. Trans. Amer. Fish. Soc., 101(3): 552-555.

Measurements were made of the time necessary for common shiners to recover from galvanonarcosis after current was no longer applied. This study, hopefully, will help to establish a basic energy threshold for electrofishing which could be extrapolated to various sampling situations.

15598. Kroger, Richard L., and James F. Guthrie (NMFS, Atlantic Coastal Fish. Center, Beaufort, North Carolina 28516). 1972. OCCURRENCE OF THE PARASITIC BRANCHIURAN, Argulus alosae, ON DYING ATLANTIC MENHADEN, Brevoortia tyrannus, IN THE CONNECTICUT RIVER. Trans. Amer. Fish. Soc., 101(3): 559-560.

Dying adult Atlantic menhaden Brevoortia tyrannus (Latrobe) infested with the parasitic branchiuran Argulus alosae Gould were collected from the Connecticut River at Old Saybrook, Connecticut, on 26 September 1970. Examination of 50 dying menhaden (average 300 mm fork length) showed that each was heavily infested with argulid fish lice. Dead menhaden were scattered along the shore and in the river. This is the first reported occurrence of A. alosae on menhaden. A. alosae

is probably of economic importance since heavy infestations of other fish lice species have destroyed entire fish populations in confined environments such as pools and lakes.

15599. Coble, Daniel W. (Wis. Coop. Fish. Unit., Coll. of Natural Resources, Univ. of Wis., Stevens Point, Wisconsin 54481). 1972. VULNERABILITY OF FIN CLIPPED BLUEGILL TO LARGEMOUTH BASS PREDATION IN TANKS. Trans. Amer. Fish. Soc., 101(3): 563-565.

Predation does not appear to be an important cause of extra mortality of fin clipped fish. This study was carried out in such a manner that predation would be the only cause of mortality. Yet after eight or ten experiments there was not a significant difference in survival of fin clipped and control fish.

15600. Kottcamp, Glenn M., and Peter B. Moyle (Dept. of Biol., Fresno State Coll., Fresno, California 93710). 1972. USE OF DISPOSABLE BEVERAGE CANS BY FISH IN THE SAN JOAQUIN VALLEY. Trans. Amer. Fish. Soc., 101(3): p. 566.

This note reports the surprisingly heavy use of disposable beverage cans, for shelter and breeding by six species of fish in streams of the San Joaquin Valley, California, including juveniles of three species of game fish.

15601. Ducharme, L. J. Andre (Dept. of the Environment, Fisheries Service, P. O. Box 550, Halifax, Nova Scotia, Canada). 1972. ATLANTIC SALMON (Salmo salar) REHABILITATION IN THE EAST RIVER, SHEET HARBOUR, NOVA SCOTIA - PROJECT DESCRIPTION AND INITIAL RESULTS. Resource Develop. Branch, Fish. Serv., Halifax, Nova Scotia, Progress Report No. 4, 31 p., illus.

A description is given of a project to reinstate Atlantic salmon (Salmo salar) in a river system containing multiple water impoundments and hydro stations in its lower reaches. Detail historical background, physical and biological descriptions of the system are given. To initiate a new salmon run, adult fish were transported from a nearby river and released to spawn naturally in the recipient stream. Louver deflectors were built in a diversion canal to protect the seaward smolt migrations from the hazards of turbines. A trapping and trucking facility was constructed at head of tide to provide returning adults access to the upriver spawning grounds. Detail descriptions are given of these facilities and preliminary results are also given. Egg to smolt survival of the progeny ranged from 1.42 to 2.28 percent and the adult return from the sea has been up to 4.0% of the smolt escapement. The report contains 5 photographs and 7 drawings. (Auth.)

15602. Elson, P. F., J. W. Saunders, and V. Zitko (Biol. Sta., St. Andrews, New Brunswick, Canada). 1972. IMPACT OF FOREST-BASED INDUSTRIES ON FRESHWATER-DEPENDENT FISH RESOURCES IN NEW BRUNSWICK. Fish. Res. Bd. of Canada Technical Report No. 325, 26 p.

A position paper, requested by the New Brunswick Forest Resources Study, on freshwater-dependent fisheries of New Brunswick in relation to forest resources.

15603. McAllister, William A., Jr., Wilbur L. Mauck, and Foster L. Mayer, Jr. (Fish Pesticide Res. Lab., Bur. of Sport Fish. & Wildl., U. S. Dept. of the Interior, Columbia, Missouri 65201). 1972. A SIMPLIFIED DEVICE FOR METERING CHEMICALS IN INTERMITTENT-FLOW BIOASSAYS. Trans. Amer. Fish. Soc., 101(3): 555-557.

15604. McCarraher, D. B., and Robert E. Thomas (Nebraska Game and Parks Comm., Hastings Coll., Hastings, Nebraska 68901). 1972. ECOLOGICAL SIGNIFICANCE OF VEGETATION TO NORTHERN PIKE, Esox lucius, SPAWNING. Trans. Amer. Fish. Soc., 101(3): 560-563.

15605. Butler, Robert L., and Frank Bologa (Bur. of Sport Fish. & Wildl., Pa. Coop. Fish. Unit, Pa. State Univ., University Park, Pennsylvania 16802). 1972. A LIGHTWEIGHT STURDY LIVE BOX FOR FISHERY WORK. Progr. Fish-Cult., 34(3): p. 182.

15606. Michigan Dept. of Natural Resources, Bureau of Water Management, Lansing, Michigan. 1972. CHLORINATED MUNICIPAL WASTE TOXICITIES TO RAINBOW TROUT AND FATHEAD MINNOWS. Copy available from GPO Sup Doc as PB-209-890, Environ. Protection Agency, Research and Monitoring, Water Pollution Control Research Series, Oct. 1971, 49 p.; Selected Water Resources Abstracts, 5(16), p. 62.

Effect of chlorinated municipal wastes on fish life and laboratory findings of earlier researchers were assessed in separate studies at four Michigan municipal wastewater treatment plants. Tolerance levels and river length below each plant outfall rendered unavailable to resident fish populations were determined. Chlorine in municipal wastewater discharges is usually present in combined form with ammonia, ammonium hydroxide or ammonium ions to form mono-, di-, or trichloramine. Ten rainbow trout (Salmo gairdneri) and ten fathead minnows (Pimephales promelas), previously acclimated, were held 96 hours in live boxes in the stream above and below these outfalls. Fish held below these outfalls were subjected to both chlorinated and non-chlorinated exposures during effluent discharge. Test waters were monitored chemically and bacteriologically during the fish exposure. Total residual chlorine concentrations below three plants were toxic to rainbow trout at distances up to 0.8 mile. Fathead minnows appeared adversely affected up to 0.6 mile downstream in two of the four plants. Total residual chlorine concentrations less than 0.1 mg/l were toxic to fathead minnows. Rainbow trout 96-hour total residual chlorine TL-50 concentration below two plants was 0.023 mg/l.

15607. Neill, W. H., and J. J. Magnuson (Water Resources Center, Wisconsin Univ., Madison, Wisconsin). 1972. DISTRIBUTIONAL ECOLOGY AND BEHAVIORAL THERMOREGULATION OF FISHES IN RELATION TO HEATED EFFLUENT FROM A STEAM-ELECTRIC POWER PLANT (LAKE MONONA, WISCONSIN.) Available from NTIS as PB-209 895. Wis. Water Resources Center, Madison, Partial Technical Completion Report, 89 p.; Selected Water Resources Abstracts, 5(16): p. 67.

Cooling water for a 220-megawatt power plant is pumped from 5 m beneath Lake Monona's surface, heated about 10 C, and discharged into the littoral zone. Maximum temperatures in the effluent-outfall area approach 35 C in summer, and 14 C in winter; unheated parts of the littoral zone rarely exceed 29 C. To assess the distributional responses of fish to the operation of the power plant, the outfall area and two reference areas were electro-fished thirty times over a one-year period. Some fishes found in the reference areas avoided the outfall area, whereas other fishes were at higher concentration in the outfall area relative to the reference sites. The tendency for a species-size class to concentrate in or avoid the outfall area generally did not reverse from season to season or from day to night. Size-dependent movements of the fish tended to obscure the difference in growth rate of young fishes between study areas. Integrated laboratory studies on six species and field results suggest that fishes were distributed within the outfall area according to their different temperature preferenda. Also, thermoregulatory behavior was overridden by feeding behavior even though zooplankton food was more abundant in the outfall area.

15608. Yashouv, A. (Fish Culture Research Sta., Dor, Israel). 1972. EFFICIENCY OF MULLET GROWTH IN FISHPONDS. Bamidgeh, 24(1): 12-25.

Mugil cephalus was reared successfully in polyculture with Mugil capito, Tilapia aurea and Cyprinus carpio.

15609. Mazmanidi, N. D., and S. K. Krasnov (Saratov Div. of the State Scientific Research Inst. of Lake and River Fishery, Saratov, USSR). 1970. PRINCIPLES FOR CONDUCTING FORENSIC ICHTHYOLOGICAL EXAMINATIONS (Osnovy Provedeniya Sudebnoikhtiologicheskoĭ ėkspertizy). Voprosy Vodnoĭ Toksikologii, Publisher "Nauka", Moscow, 1970, pp. 53-57. Translated by Robert M. Howland, September 1971.

15610. Kennedy, H. D., and D. F. Walsh (Bur. of Sport Fish. & Wildl., Columbia, Missouri). 1970. EFFECTS OF MALATHION ON TWO WARMWATER FISHES AND AQUATIC INVERTEBRATES IN PONDS. Technical Paper 55, 3-13; Selected Water Resources Abstracts, 5(16): p. 73.

Bluegills and channel catfish were exposed to 4 applications of malathion at 2 concentrations in ponds over an 11-wk summer period. Fish losses ranged from 8 to 44% but could not be correlated with treatment levels. Fish growth or microhematocrit values were not significantly different between treated and untreated ponds. Neither acute nor chronic pathology developed, nor were depressions in the brain cholinesterase activity significant or reproducible. Bluegills spawned twice, with approximately 340, 000 progeny collected at the conclusion of the study. The first spawn, of approximately 5000, was in early June; the second spawn, in early Aug., approximated 335, 000. The total number of aquatic insects from plate sampling the low-treated ponds was not significantly lower than that from the untreated ponds, but the number of organisms from the high-treated ponds was significantly lower than that from either the low-treated or untreated ponds. Chironomidae was the dominant family of aquatic insects, and formed about 70% of the total benthos. This group showed a significant reduction in numbers in both low- and high-treated ponds after the third application of malathion. Baetid mayflies formed about 24% of the benthos and were definitely reduced in both low- and high-treated ponds after third application. Heptageniid mayflies formed about 5% of the benthos and were scarce. They failed to recover after the third treatment. Other groups of insects formed less than 1% of the total benthos. They probably had not become well enough established in these immature ponds to measure significant effects of malathion. - Copyright 1972, Biological Abstracts, Inc.

15611. Pickering, Quentin H., and Marion H. Gast (U.S. Environ. Protection Agency, NWQL, Cincinnati, Ohio 45244). 1972. ACUTE AND CHRONIC TOXICITY OF CADMIUM TO THE FATHEAD MINNOW (Pimephales promelas). J. Fish. Res. Bd. Canada, 29(8): 1099-1106.

Two continuous-flow bioassays on the chronic toxicity of cadmium to the fathead minnow (Pimephales promelas Rafinesque) indicated that the maximum acceptable toxicant concentration (MATC) for this species is between 57 and 37 μg Cd/liter. The experimental concentration of 57 μg Cd/liter decreased survival of the developing embryos, the embryos being the most sensitive life stage. At lower concentrations of 37 to 4.5 μg Cd/liter, no adverse effect on survival, growth, or reproduction was found. Application factors based on the acute bioassays are discussed in relation to the great variation in toxicity values. (Authors)

15612. McCormick, J. Howard, Kenneth E. F. Hokanson, and Bernard R. Jones (Environ. Protection Agency, NWQL, Duluth, Minnesota 55804). 1972. EFFECTS OF TEMPERATURE ON GROWTH AND SURVIVAL OF YOUNG BROOK TROUT, Salvelinus fontinalis. J. Fish. Res. Bd. Canada, 29(8): 1107-1112.

Instantaneous rates of growth, mortality, and net biomass gain were determined for alevin through juvenile brook trout reared for 8 weeks at six constant temperatures: 7.1, 9.8, 12.4, 15.4, 17.9, and 19.5 C. Growth rates were maximum between 12.4 and 15.4 C. Mortality rates increased between 15.4 and 17.9 C and were maximum between 17.9 and 19.5 C. The net rates of biomass gain were maximum between 12.4 and 15.4 C. Median upper thermal tolerance limits (TL50 values) were determined for newly hatched and swim-up alevins. Tolerance did not increase in newly hatched alevins with acclimation to temperatures from 2.5 to 12 C. The upper 7-day TL50 for newly hatched alevins acclimated over this range of temperatures was 20.1 C. The swim-up alevins showed both an increase in temperature tolerance with acclimation temperatures between 7.5 and 12 C and an increase in tolerance over that of the newly hatched alevins at comparable acclimation temperatures. The ultimate 7-day TL50 of swim-up alevins was 24.5 C. Swim-up alevins exceed newly hatched alevins in thermal tolerance by 2.0-4.5 C, depending on the temperature of acclimation. The TL50 of newly hatched alevins of comparable acclimation (12 C) is reduced by about 2 C when the exposure time is increased from 1 to 7 days. (Authors)

15613. Messieh, Shoukry N. (Fish. Res. Bd. of Canada, Biol. Sta., St. Andrews, New Brunswick, Canada). 1972. USE OF OTOLITHS IN INDENTIFYING HERRING STOCKS IN THE SOUTHERN GULF OF ST. LAWRENCE AND ADJACENT WATERS. J. Fish. Res. Bd. Canada, 29(8): 1113-1118.

Examination of 1423 herring from various fisheries in the southern Gulf of St. Lawrence and adjacent waters indicates that otoliths can be used as "natural tags" for identifying herring stocks. Two types of otoliths are described: an S-type characterizing spring-spawning herring and an A-type characterizing autumn-spawning herring. Over 97% of herring from spring and autumn fisheries had otoliths of the respective types. There appeared to be sub-divisions within each type. The distinguishing of these otolith types provides evidence that spring- and autumn-spawning herring mix on American Bank and off Shippegan in the Gulf of St. Lawrence and in Chedabucto Bay. The validity of otolith types as criteria for separating herring stocks was supported by comparison with relations of otolith length to fish length and with fin ray counts. (Auth.)

15614. Jones, Barry C. (Dept. of Zool., Univ. of Brit. Columbia, Vancouver, British Columbia, Canada). 1972. EFFECT OF INTERTIDAL EXPOSURE ON SURVIVAL AND EMBRYONIC DEVELOPMENT OF PACIFIC HERRING SPAWN. J. Fish. Res. Bd. Canada, 29(8): 1119-1124.

Eggs of Pacific herring were exposed to air for different periods of time to simulate tidal effects on spawn deposits at varying beach heights on the British Columbia coast. Prehatching mortality changed from 13% unexposed to 31% at 8-hr exposure twice daily. Significantly higher mortality occurred among eggs of smaller fish and eggs in smaller clumps. Incubation time decreased from 19.2 to 18.2 days with 2-hr exposure twice per day, and thereafter declined 0.4 days with greatest exposure. Larval length at hatching for unexposed eggs was 7.7 mm; lengths for all degrees of exposure were similar (7.2 mm). Larval weight was greatest (0.099 mg) for eggs exposed between 4 and 6 hr twice per day, decreasing with either greater submergence or exposure (7 and 12% respectively). Hypoxia, desiccation, and the air-water temperature differential are considered as possible causal agents. A field survey indicated that deposition of larger eggs occurred at upper beach levels. These results suggest that a high fishing intensity could detrimentally affect future spawn and thereby reduce population recruitment. (Auth.)

15615. Beamish, Richard J., and Harold H. Harvey (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1972. ACIDIFICATION OF THE LA CLOCHE MOUNTAIN LAKES, ONTARIO, AND RESULTING FISH MORTALITIES. J. Fish. Res. Bd. Canada, 29(8): 1131-1143.

The loss of populations of lake trout (Salvelinus namaycush), lake herring (Coregonus artedii), white suckers (Catostomus commersoni), and other fishes in Lumsden Lake was attributed to increasing levels of acidity within the lake. An absence of fishes was also observed in nearby lakes. In some lakes, acid levels have increased more than one hundredfold in the last decade. The increases in acidity appear to result from acid fallout in rain and snow. The largest single source of this acid was considered to be the sulfur dioxide emitted by the metal smelters of Sudbury, Ont. In 1971, pH measurements were taken from 150 lakes in the general study area 65 km southwest of Sudbury. Some 33 of these lakes showed a pH of less than 4.5 and were described as "critically acidic." An additional 37 lakes had a pH in the range of 4.5-5.5 and were termed "endangered" lakes. (Authors)

15616. Larson, Gary Lee (Coll. of Fisheries, Univ. of Wash., Seattle, Washington). 1972. GONAD MATURATION OF BROOK TROUT (Salvelinus fontinalis) IN A HIGH MOUNTAIN LAKE UNDER A MODIFIED PHOTOPERIOD. J. Fish. Res. Bd. Canada, 29(8): 1209-1211.

Gonad maturation of brook trout (Salvelinus fontinalis) in Pratt Lake appeared similar to those reported for other areas although the day-length cycle was greatly modified by snow cover that capped the lake until early summer. (Auth.)

15617. Butler, John L., and William G. Pearcy (Dept. of Oceanography, Oregon State Univ., Corvallis, Oregon 97331). 1972. SWIMBLADDER MORPHOLOGY AND SPECIFIC GRAVITY OF MYCTOPHIDS OFF OREGON. J. Fish. Res. Bd. Canada, 29(8): 1145-1150.

Three general types of swimbladders were found in the eight species of myctophids studied: gas-filled, fat-invested, and atrophied or reduced. Small specimens of all species had thin-walled, gas-filled swimbladders. Large specimens of Stenobrachius leucopsarus had fat-invested swimbladders and large Diaphus theta had either gas-filled or atrophied swimbladders, as found by other workers. Large Tarletonbeania crenularis had either gas-filled or reduced swimbladders, large Lampanyctus ritteri and L. regalis had reduced swimbladders, and large Stenobrachius nannochir had fat-invested swimbladders. Protomyctophum thompsoni and P. crockeri retained gas-filled swimbladders. High body lipid content was found in S. leucopsarus, S. nannochir, L. ritteri and D. theta, and low lipid content was found in the other four species. Myctophids with high lipid content had specific gravities close to that of sea water (1.026-1.030). Tarletonbeania crenularis with reduced swimbladder had a specific gravity of 1.088. Lampanyctus regalis had a lower specific gravity (1.040) due to high water content of the tissue. The swimbladder to body volumes in S. leucopsarus and D. theta were inversely related to body size and lipid content, indicating that lipids assume the primary buoyancy function as the gas-filled swimbladder regresses with age. This change may eliminate the physiological constraints imposed by a gas-filled swimbladder and permit the more extensive diel vertical migrations of adults. (Authors)

15618. Bams, R. A. (Fish. Res. Bd. of Canada, Pacific Biol. Sta., Nanaimo, British Columbia, Canada). 1972. A QUANTITATIVE EVALUATION OF SURVIVAL TO THE ADULT STAGE AND OTHER CHARACTERISTICS OF PINK SALMON (Oncorhynchus gorbuscha) PRODUCED BY A REVISED HATCHERY METHOD WHICH SIMULATES OPTIMAL NATURAL CONDITIONS. J. Fish. Res. Bd. Canada, 29(8): 1151-1167.

To evaluate a hatchery method utilizing a gravel medium and filtered water during incubation, comparisons were made between naturally and artificially propagated parts of one native stock of pink salmon (Oncorhynchus gorbuscha) of the Tsolum River, B.C. Yolk utilization (growth rate) of fry was unimpeded in the hatchery environment, but hatchery fry migrated about 6 days earlier than creek fry. Hatchery survival was about six times that in the creek. The main test criterion - relative survival to the adult stage of fish from both treatments following migration from the creek - was tested by release of two similar groups of fry identified by a double finclip and recovery of marked adults upon return. Both groups survived at virtually the same rate. Numbers of actual mark recoveries were adequate to demonstrate statistically that survival of hatchery fish following release was not less than 90% of creek fry survival and that the final gain ratio of the hatchery treatment was not less than 5.44 ($P < .005$). Adult size, sex ratio, fecundity, and timing were not adversely affected by the hatchery treatment. (Auth.)

15619. Clayton, J. W., and D. N. Tretiak (Fish. Res. Bd. of Canada, Freshwater Inst., Winnipeg, Manitoba R3T 2N6, Canada). 1972. AMINE-CITRATE BUFFERS FOR pH CONTROL IN STARCH GEL ELECTROPHORESIS. J. Fish. Res. Bd. Canada, 29(8): 1169-1172.

Amine-citrate buffer systems for pH control in starch gel electrophoresis gave good resolution of some dehydrogenase isozymes. The pK's of three new amine buffers, N-(3-aminopropyl)-morpholine, pK_2 25 C, 6.12; N-(3-aminopropyl)-diethanolamine, pK_2 25 C, 6.90; and 1,3-bis(dimethylamino)-2-propanol, pK_2 25 C, 7.55, were determined at 5 C intervals in the range 10-40 C. These compounds, together with N, N-bis(2-hydroxyethyl)iminotris(hydroxymethyl)methane (bis-Tris) and tris-(hydroxymethyl)-methylamine(Tris), provide a series of amine buffers with pK's at 0.5 unit intervals in the pH range 6.1-8.1. (Authors)

15620. McAllister, Don E., Pierre Jolicoeur, and Hiroshi Tsuyuki (National Museum of Natural Sciences, Ottawa, Ontario, Canada). 1972. MORPHOLOGICAL AND MYOGEN COMPARISON OF JOHNNY AND TESSELLATED DARTERS AND THEIR HYBRIDS, GENUS Etheostoma, NEAR OTTAWA, CANADA. J. Fish. Res. Bd. Canada, 29(8): 1173-1180.

Ten morphological characters and two electrophoretic characters were studied in nearly 200 specimens of johnny and tessellated darters from the Ottawa area. The data were analyzed using a simple character index and principal component analysis. The frequency distribution of the character index was trimodal, and specimens could be resolved into three groups: those typical of johnny and tessellated darters, and a group of intermediates. The two extreme groups were interpreted as representing two valid species, Etheostoma nigrum Rafinesque and Etheostoma olmstedi Storer, and part of the intermediate group was inferred to consist of interspecific hybrids. Hybrids were estimated to constitute less than 7.6%. There was no clear evidence of backcrossing. Most specimens could be clearly identified with one or the other of the two species. A key is provided. (Authors)

15621. Kelso, John R. M. (Dept. of Zool., Univ. of Manitoba, Winnipeg 19, Manitoba, Canada). 1972. CONVERSION, MAINTENANCE, AND ASSIMILATION FOR WALLEYE, Stizostedion vitreum vitreum, AS AFFECTED BY SIZE, DIET, AND TEMPERATURE. J. Fish. Res. Bd. Canada, 29(8): 1181-1192.

An optimum ration was not readily apparent as conversion differed only slightly at high and low rations. Gross (K_1) and net (K_2) conversion was affected by neither ration size nor temperature, but decreased with increasing fish size. Conversion of the third order (K_3) was affected only by temperature, being greater at higher temperatures. Gross and net conversion were consistently lower at cycled temperatures, 16-8 C. Gross and net conversion were similar since the high assimilation efficiency (82.1-97.9%) of walleye (Stizostedion vitreum vitreum) did not greatly alter the latter. Assimilation efficiency was dependent upon diet type, least for invertebrates (82.1% for amphipods and 83.5% for crayfish) and greatest for fish (96.9% for age 0 perch and 97.9% for emerald shiners). Assimilation efficiency decreased with increasing walleye size (slope of -0.0045) irrespective of the food organism. Regurgitation of crayfish occurred in two of three trials, and it was not established if this was a natural phenomenon. Maintenance requirement per gram was independent of fish size, but was affected by temperature. Maintenance between temperatures of 4-12 C was similar, 33.3-45.7 cal/g walleye per week, but increased greatly above 12 C. Results from maintenance experiments paralleled Winberg's (1956) approximation of routine metabolism. (Auth.)

15622. Ware, D. M. (Inst. of Resource Ecology, The Univ. of British Columbia, Vancouver, British Columbia, Canada). 1972. PREDATION BY RAINBOW TROUT (Salmo gairdneri): THE INFLUENCE OF HUNGER, PREY DENSITY, AND PREY SIZE. J. Fish. Res. Bd. Canada, 29(8): 1193-1201.

The feeding behavior of rainbow trout (Salmo gairdneri) was investigated by exposing fish to several densities and sizes of prey over a range of four substrates of varying complexity. Within substrate treatments the rate of predation could be stimulated by increasing either prey density, prey size, or predator hunger. Between treatments, however, both the intensity of predation and total food consumption proved to be inversely related to the complexity of the substrate because a number of prey were able to find cover and thus escape detection. The results further indicate that the nature of foraging behavior may be controlled by a critical rate of food capture. If trout did not exceed an average of 0.58 captures sec^{-1}, substrate-oriented search proceeded to wane. (Auth.)

15623. Evans, David O. (Dept. of Zool., Univ. of Toronto, Toronto, Ontario, Canada). 1972. CORRECTION FOR LAG IN CONTINUOUS-FLOW RESPIROMETRY. J. Fish. Res. Bd. Canada, 29(8): 1214-1216.

The lag and damping effect caused by fluctuations in the oxygen content of the respiration chamber in continuous-flow respirometry can be eliminated by addition of the simple correction factor (chamber volume X initial - final outflow oxygen

concentration) to the ordinarily used formula (flow X mean difference between inflow and outflow oxygen concentration). Metabolism data for six rainbow trout, Salmo gairdneri, are presented. (Auth.)

15624. Byrne, J. M., F. W. H. Beamish, and R. L. Saunders (Dept. of Zool., Univ. of Guelph, Guelph, Ontario, Canada). 1972. INFLUENCE OF SALINITY, TEMPERATURE, AND EXERCISE ON PLASMA OSMOLALITY AND IONIC CONCENTRATION IN ATLANTIC SALMON (Salmo salar). J. Fish. Res. Bd. Canada, 29(8): 1217-1220.

In unexercised Atlantic salmon (Salmo salar), plasma osmolality and Na^+ and Ca^{++} concentrations varied little at temperature-salinity combinations of 3, 5, 10, and 14 C and 0, 15, and 30 °/oo. Plasma K^+ tended to increase with increase in temperature. Cl^- values were similar at 5 and 14 C. At 1 C and 0 °/oo, lower plasma osmolalities indicated reduced ability to osmoregulate. At 1 C and 30 °/oo, elevated osmolalities and ionic values and mortalities indicated severe osmotic stress. After exercise for 2 hr at 3-4 body lengths/sec at 5 and 14 C, salmon in salinities of 0 and 15 °/oo had osmolalities and ionic values the same as or little changed from unexercised values. There were marked increases in the values following exercise in 30 °/oo. (Authors)

15625. Wilson, R. C. H. (Dept. of the Environ., Fish. Service, St. John's, Newfoundland, Canada). 1972. ACUTE TOXICITY OF SPENT SULPHITE LIQUOR TO ATLANTIC SALMON (Salmo salar). J. Fish. Res. Bd. Canada, 29(8): 1225-1228.

Ninety-six hour static bioassays, with daily toxicant replenishment, were performed on Atlantic salmon (Salmo salar) parr to test for the acute toxicity of spent sulphite liquor (SSL). The LC50 of two batches of fresh SSL varied from 2000 to 2400 ppm, while the LC50 of SSL which had been previously oxidized for 5 days was 2750 ppm. Test fish responded differently to oxidized than to fresh SSL. Caution is urged in the application of 96-hr bioassay results on sulphite pulp mill wastes to field situations. (Auth.)

15626. Thomas, Martin L. H., and Elizabeth Jelley (Fish. Res. Bd. of Canada, Marine Ecol. Lab., Bedford Inst., Dartmouth, Nova Scotia, Canada). 1972. BENTHOS TRAPPED LEAVING THE BOTTOM IN BIDEFORD RIVER, PRINCE EDWARD ISLAND. J. Fish. Res. Bd. Canada, 29(8): 1234-1237.

Inverted funnel traps, designed to catch animals swimming up from the bottom, set in Bideford River estuary, P. E. I., during the summer of 1969 caught numerous benthic and hyperbenthic invertebrates. Many crustaceans generally considered to be planktonic appeared to enter the substratum during the day and to leave it at night. Several polychaetes, some of which were not known to swim, were regularly collected. The average catch per square meter per day was 23 individuals, amounting to 0.08 g (decalcified dry weight). (Authors)

15627. Hodges, John W. (U. S. Fish & Wildl. Serv., Ludington, Michigan 49431). 1972. DOWNSTREAM MIGRATION OF RECENTLY TRANSFORMED SEA LAMPREYS BEFORE AND AFTER TREATMENT OF A LAKE MICHIGAN TRIBUTARY WITH A LAMPRICIDE. J. Fish. Res. Bd. Canada, 29(8): 1237-1240.

After the Pere Marquette River was treated with a lampricide in May 1964, the number of recently transformed sea lampreys (Petromyzon marinus) collected in the water-intake structure of a chemical plant near the mouth of the stream dropped 99.5%, from 13,913 (average for 1962-63 and 1963-64) to 76 (average for the next four migration seasons). Average length of the lampreys caught increased markedly after the treatment. In five of the six migration seasons, the catch of downstream migrants was higher in the fall than in the spring. (Auth)

15628. Merriner, John V. (Va. Inst. of Marine Science, Gloucester Point, Virginia 23062). 1972. A HERMAPHRODITIC ALEWIFE, Alosa pseudoharengus, FROM THE RAPPAHANNOCK RIVER, VIRGINIA. Copeia, No. 3, p. 597, illus.

15629. Miller, Robert Rush. 1972. CLASSIFICATION OF THE NATIVE TROUTS OF ARIZONA WITH THE DESCRIPTION OF A NEW SPECIES, Salmo apache. Copeia, No. 3, pp. 401-422.

A new species of trout, Salmo apache, is described from the White Mountains of eastern Arizona, in the Gila and Little Colorado River drainages. Specimens collected in 1873, 1915, 1937, and 1950, along with reliable information on trout introductions and study of collections made in the last decade, assure that certain stocks still persisting today are pure. Survival of the species has been greatly aided by the foresight of the White Mountain Apache Tribe. A second trout, Salmo gilae Miller (described from New Mexico), was also native to Arizona (as shown by 1888-1889 material from Oak Creek) but was eliminated after 1900. Salmo apache is distinguished by a set of characters involving life colors, spotting, body proportions, numbers of scales, vertebrae, and pyloric caeca, occasional presence of basibranchial teeth, and by its karyotype (2n = 56). It is compared with Salmo chrysogaster (of Mexico), S. clarki, S. aguabonita, S. gilae, and S. gairdneri, with some osteological observations included. Chromosomes show promise for helping to determine relationships in the genus Salmo, although much more data are needed. Speculations are presented on the origin of the trouts of Arizona, with information on an important Mexican fossil (Plio-Pleistocene) that may be closely related to S. chrysogaster. I conclude that the latter species represents a distinct phyletic line of Salmo, evidently the most primitive one in western North America, and that there are at least three other evolutionary lines. It is suggested that the California golden trout was derived from an ancestor (or combination of ancestral forms) that entered the Sacramento-San Joaquin Valley from the north, where it is perhaps represented today by the redband trout of McCloud River basin, California. (Auth.)

15630. Potter, I. C., and J. R. Bailey. 1972. THE LIFE CYCLE OF THE TENNESSEE BROOK LAMPREY, Ichthyomyzon hubbsi Raney. Copeia, No. 3, pp. 470-476.

Larval, metamorphosing, and adult stages of Ichthyomyzon hubbsi were collected at several different times of the year from the Mills River and Bent Creek, two tributaries of the French Broad in North Carolina. Analysis of length-frequency data for ammocoetes, indicated that the duration of larval life is at least 5-1/4 and probably 6-1/4 years. The growth rate was most marked during the spring and summer and gradually decreases during larval life with little or no increase in length occurring in the year prior to metamorphosis. The external signs of metamorphosis first appeared in transforming animals between early August and the middle of September, and spawning took place in the following May or early June. The results are discussed in the context of estimates on the duration of the life cycle of paired species of lampreys. (Authors)

15631. Zorach, Timothy. 1972. SYSTEMATICS OF THE PERCID FISHES, Etheostoma camurum AND E. chlorobranchium NEW SPECIES, WITH A DISCUSSION OF THE SUBGENUS Nothonotus. Copeia, No. 3, pp. 427-447.

Etheostoma camurum is redescribed, figured, and a detailed synonymy is presented. Its close allopatric relative, E. chlorobranchium new species, is figured and described from the upper Tennessee River System where it apparently is restricted to upland streams. These species differ distinctly in life coloration of the males. Geographic variation in meristic details and coloration of the two species is considered. The evolutionary relationships and dispersal of the species in the subgenus Nothonotus are discussed and a key to the identification of the species is presented. Two distinct groups are recognized in the subgenus and two species are considered as distant relatives. (Auth.)

15632. Lea, Robert N., and John E. Fitch. 1972. Sebastes rufinanus, A NEW SCORPAENID FISH FROM CALIFORNIAN WATERS. Copeia, No. 3, pp. 423-427.

A new Californian rockfish, Sebastes rufinanus, is described from two specimens that were killed by an underwater explosion near San Clemente Island (32° 47.8' N, 118° 20' W). This dwarf rockfish is distinguished from all other

eastern Pacific species of Sebastes, except S. diploproa, by a combination of two characters: a low number of pored scales in the lateral line and the lack of supra-ocular spines. It is readily distinguished from S. diploproa by a lack of prominent dentigerous knobs on the snout. Its discovery brings to 57 the number of species of Sebastes known from Californian waters. (Authors)

15633. Feldmeth, C. Robert and John P. Waggoner III (Joint Sci. Dept., Claremont Colleges, Claremont, California 91711). 1972. FIELD MEASUREMENTS OF TOLERANCE TO EXTREME HYPERSALINITY IN THE CALIFORNIA KILLIFISH, Fundulus parvipinnis. Copeia, No. 3, pp. 592-594.

The purpose of this study was to determine blood osmotic concentrations and tissue water content for Fundulus parvipinnis in hypersaline field environments. A substantial increase in blood osmolality occurred for fish living in 87 °/oo and 120 °/oo. Similarly a significant decrease in tissue water content was present for fish from salinities greater than 60 °/oo. However, Fundulus parvipinnis is able to tolerate total salt concentrations of up to 128 °/oo by assuming a blood osmotic increase of over 100 m Osm/l and a tissue water loss of over 5% without apparent difficulty. Thus, though F. parvipinnis appears to be losing osmotic regulatory ability in salinities greater than 60 °/oo it is able to exploit habitats of twice this concentration by toleration of an increased osmotic concentration of its body fluids.

15634. Herdendorf, Charles E., and Lawrence L. Braidech. 1972. PHYSICAL CHARACTERISTICS OF THE REEF AREA OF WESTERN LAKE ERIE. State of Ohio Department of Natural Resources, Report of Investigations No. 82, 90 p. + 7 plates.

Thirteen major reefs, which occupy about 8 square miles, and 12 major islands are present in the reef area of western Lake Erie. The reefs and islands are composed of Silurian and Devonian dolomite and limestone, allochthonous rubble, and glacial gravel, and are elongated northeast - southwest because of the structure and relative resistance of the bedrock, orientation of glacial scour, and dominant current directions. Surface sediment samples at 1,383 stations indicated that the bottom was composed of mud (58.5 percent), sand (26.2 percent), gravel (9.4 percent), and exposed bedrock (5.9 percent). Cores at 280 stations revealed the following sequence of subsurface sediments above the bedrock: (1) glacial till clay, (2) compacted lake clay, (3) softer lake clay containing abundant plant detritus, and (4) recent mud and sand. Lag sand and gravel deposits form a thin veneer over the glacial till in the Locust Point Reef area. East and west of the Bass Islands accumulations of plant detritus represent a low-water stage (radiocarbon dates 11,300 to 4,300 years B.P.). Contemporary sedimentation studies on six reefs and in two deep areas revealed that sediment deposition rates are seasonal, with the highest rates and deposition of the largest particles in the spring. No permanent sedimentation appears to be occurring on the reefs. Wind, bottom topography, and shoreline configuration are the major factors controlling current patterns. Surface currents are normally driven downwind while bottom currents are often opposed to the wind in the form of a compensating return flow. Repetitive measurements at 68 stations revealed average velocities of 0.28 knot for surface currents and 0.15 knot for bottom currents. Because of the shallowness, currents and associated water-level fluctuations stir the entire water column, producing nearly isothermal conditions throughout the year. (Authors)

******

AUTHOR INDEX FOR VOLUME 17

Abbott, O. J., 15307
Abbott, Robert Riley, 14728
Abe, Isao, 14834
Abrams, J. P., 15300
Acton, Ronald T., 14468
Adams, B. L., 15050
Adams, William J., 15597
Addison, Joseph H., 15503
Addison, R. F., 15111, 15265
Adkins, Gerald B., 14436
Adron, J. W., 15044, 15317
Afanas'yev, V. I., 15485
Ager, Lothian, 14661
Ahlstrom, Elbert H., 14645
Akhmerov, A. Kh., 14964
Alderdice, D. F., 14602, 15144
Alderton, Pamela, 14358
Ali, M. Y., 14493
Allen, George W., 14350
Allen, K. Radway, 14604
Allen, Kenneth O., 14334, 14446
Alpaugh, Walter C., 14748
Alton, Miles S., 15461
Amend, Donald F., 15034, 15175, 15207, 15301, 15556
Anastassiadis, P. A., 14294
Anderson, Douglas P., 15085
Anderson, Emory D., 14450
Anderson, J. M., 14498, 15029
Anderson, William D., Jr., 15585
Andrews, Austin K., 14724
Andrews, James W., 14362, 14363 14733, 14892, 14893, 15116
Andreyev, V. L., 15224
Andruetto, S., 15306
Andrusak, H., 14496
Annett, Charles S., 14256
Anonymous, 14283
Anthony, A., 15572
Antonini, Eraldo, 14694
Anwar, M., 15315
Aoe, Hiroshi, 14834
Aoki, Takashi, 14837
Apazidi, L. Kh., 15448
Applegate, Vernon C., 15324
Arai, Hisao P., 14606
Arcarese, G., 15305
Arita, George S., 14554
Armstrong, F. A. J., 14590, 14762
Arnold, Connie R., 14793, 15102
Arnott, H. J., 15062
Aronson, Arthur L., 14575
Arsan, O. M., 14524
Arshanitsa, N. M., 15000
Arthur, John W., 14972
Atmar, Gerald L., 15417
Atton, F. Mervyn 15371
Aulstad, D., 14981, 15142
Avault, James W., Jr., 14325, 14334, 14354, 15512, 15535
Avedikova, T. M., 14913
Avtalion, R. R., 14597, 15006

Bach, R., et al., 14624
Bache, Carl A., 14577, 14618, 14620
Bachop, William, 14465
Backiel, Tadeusz, 14259
Bagenal, T. B., 14907
Bahns, Timothy K., 14462, 14906
Bahr, Thomas G., 14715
Bailey, J. R., 15630
Bailey, Jack E., 14271
Bailey, William, 14682
Bakkala, Richard G., 14633
Balakhnin, I. A., 14535, 15408
Baldwin, John, 14413, 15033
Bams, R. A., 15618
Banerjee, Tapan, 14244
Banks, J. W., 14260
Banks, Joe L., 15302
Baptist, J. P., 14588, 14764
Barker, C. J., 15206
Barkley, Sammy W., 14666, 15505
Barlow, George W., 14747, 14813
Barnes, C. A., 14254
Barnhart, Roger A., 15463
Barraclough, W. E., 14505, 14647
Barrett, Barney B., 14436
Barry, Thomas L., 14622
Bartholomew, J. Phillip, 15014
Bartnik, V. G., 14804
Bass, Eugene L., 14560
Bates, Daniel W., 14772
Batts, Billy S., 15447
Bauer, O. N., 14422
Baumeister, Robert, 15126
Baumgarten, D., 15058
Bayliff, William H., 14632, 15452
Beam, Martin G., 14772
Beamer, Tim, 14411
Beamish, F. W. H., 14627, 14805, 15537, 15624
Beamish, R. J., 14759, 15137, 15157, 15191, 15615
Bearden, Charles M., 14556, 15177
Beardsley, Grant L., Jr., 14983
Beatty, D. D., 15475
Becker, C. D., 14278, 14721
Becker, David A., 14277
Bedinger, C. A., Jr., 14790
Beeton, A. M., 15281
Behmer, David J., 15597
Behnke, Robert J., 14235, 15282
Beiningen, Kirk T., 14226
Bell, Gordon R., 14601
Bellinger, John W., 14674
Bellman, Sander W., 14622
Bender, Michael E., 15181
Ben'do, K. I., 14530
Bennett, David H., 15092

Bennett, J. Claude, 14468
Benville, P. E., Jr., 14718, 14945
Benzhitskiy, A. G., 14527
Berdyshev, G. D., 14800
Berg, A., 14312
Berinati, D. J., 14711, 14771
Bernatowicz, Stanislaw, 15292
Berst, A. H., 15343
Bertmar, Gunnar, 15476
Bhatia, H. L., 14745
Białokoz, Witold, 15276
Bibby, M. C., 15208
Bida, Gerald, 14581
Bieniarz, Krzysztof, 14997
Bigliocca, Carla, 14312
Bilinski, E., 14239
Bilton, H. T., 14760, 14761, 15147
Bingham, C. Rex, 14330
Binotti, Ines, 14694
Bird, John W. C., 15055, 15056
Birdsong, Charles L., 14325
Bjornn, T. C., 14458
Blackburn, Christine J., 15461
Blackburn, R. D., 15065
Blanz, Robert E., 14331
Blazek, D., 14692
Blease, J. A., 14976
Blinn, D. W., 15134
Bliss, Q. P., 14454
Bloomfield, Richard A., 15450
Bobrova, Yu. P., 14737
Bock, K. J., 15569
Boddingius, J., 14635
Bodien, Danforth G., 14720
Boese, Helen, 14503
Bogdanova, E. A., 14964
Boggess, T. S., Jr., 15041
Bohn, Burnell R., 14229
Bologa, Frank, 15605
Bond, H. W., 14905
Bonham, Kelshaw, 15576
Booth, Douglas E., 14993
Bootsma, R., 14262, 15013
Borjeson, Hans, 15159
Born, Stephen, 15024
Bortone, Stephen A., 14641
Boström, S-L., 15059
Bothern, C. R., 15204
Bouck, Gerald R., 15586
Bourget, E., 14299
Boyd, Claude E., 15245, 15508, 15595
Boyd, Randy, 14677, 14682
Bradley, W. Glen, 15574
Brand, James S., 14700
Branover, G. G., 15231
Brauhn, James L., 14372, 14704, 15101
Bresching, Gisela, 15568
Brett, J. R., 14611, 14825, 14969
Brezina, Edward R., 15373
Bridges, David Wilder, 14255
Bridges, W. R., 15319
Briggs, Kenneth T., 14817
Briggs, Philip T., 14613
Brinkhurst, R. O., 14753, 14754, 14755
Bromley, P. J., 15124
Brown, Bradford E., 14679
Brown, Clinton E., 14233
Brown, E. Evan, 14363
Brown, E. H., Jr., 15253
Brown, James H., 14433
Brownell, Willard N., 14356
Bruger, Gerard E., 14947
Brungs, William A., 14289, 14444
Brunori, Marizio, 14694
Brunskill, G. J., 14762
Brylinska, Maria, 15276
Brynildson, O. M., 15220
Buchanan, Thomas M., 14332
Buck, John D., 15150
Bucke, David, 14263
Bugay, K. S., 14931
Bulatovich, M. A., 14530
Bulkley, Ross V., 15584, 15593
Bullard, Elizabeth B., 14448
Bullock, G. L., 14949
Buntz, Jon, 14333
Burck, Wayne A., 14231
Burdick, George E., 15538
Burgner, R. I., 15326
Burns, James W., 14725
Burrell, V. G., Jr., 14459, 14690
Burress, Ralph M., 14673
Burris, Kenneth Wayne, 15061, 15399
Burton, Dennis Thorpe, 14275, 14276, 14881, 14906, 15578
Bushuyev, V. P., 14916
Butler, D. P., 14702
Butler, David G., 14883, 15298, 15546
Butler, Jerry A., 14572
Butler, John L., 15617
Butler, Robert L., 15605
Byles, Thomas C., 15558
Byrne, J. M., 15624
Byrne, John E., 14322, 14630

Cahn, Phyllis H., 14654
Caillouet, Charles W., 14355, 14412, 14701
Cairns, John, Jr., 14276, 14287, 14359, 14410, 14411, 14456, 14462, 14491, 14773, 14906, 15115, 15141, 15244, 15295, 15451, 15544, 15550, 15578
Cala, Plutarco, 15158
Calaprice, J. R., 14605, 14969
Cameron, James N., 14559
Campbell, Homer J., 14539
Campbell, N. A., 15291
Campbell, R. N., 15242
Campbell, Robert S., 15299, 15373, 15391
Cannon, L. R. G., 14570

Cardwell, R. C., 15458
Cardwell, Rick D., 14373, 15272
Carlander, K. D., 14579, 14580
Carline, Robert F., 15174, 15220
Carlson, A. R., 15263, 15589
Carlson, C. P., 15077
Carlson, Clarence A., 15219
Carlson, Frank T., 14995
Carlson, H. Richard, 15425
Carlson, Jack, 14365
Carnes, W. Cape, 14658
Carpenter, M. Ralph, 14895
Carpenter, Stanley J., 15149
Carr, Amy E., 15240
Carter, W. R., III, 14686
Casida, John E., 14279
Castell, J. D., 15117, 15118, 15120
Castle, William T., 15462
Chadwick, George C., 14959
Chadwick, Harold K., 15579
Chamberlain, Lawrence L., 14814
Chambers, Howard, 14533, 15127
Champ, M. A., 14347
Chandler, Jack H., 15129
Chandran, S. R., 15363
Chapman, D. W., 15038, 15186
Chaykovskaya, A. V., 14521, 15409
Cheng, E. Y., 14552
Chenoweth, Stanley B., 14985
Chernyshov, V. I., 15235
Chervinski, J., 14328, 15019
Cheshire, W. F., 15096
Chichester, C. O., 15010
Chien, Shih Ming, 14469
Child, A. R., 15203
Childers, William F., 14799, 14886, 14953, 15052, 15054, 15068, 15356
Chiszar, David, 15261
Chittenden, Mark E., Jr., 14739, 14970
Cho, P., 15052
Cho, Paula L., 14886
Christensen, G. M., 14640
Christie, W. J., 15347, 15352
Chua, Dixie, 14803
Chuba, J. V., 14300
Churchill, Sharon, 14411
Clark, William E., 14940
Clarke, W. Craig, 15078
Clary, James Robert, 15094
Clayden, A. D., 15567
Clayton, J. W., 14238, 15619
Clemmer, Glenn H., 14321
Clifford, Hugh F., 15434
Cline, Thomas F., 15557
Clutter, Robert I., 15491
Coble, Daniel W., 14234, 15599
Colby, Peter J., 14248, 14440, 15353, 15577
Collins, John J., 14975
Collins, Richard A., 14346, 14676, 15273, 15274
Collins, Robson A., 14419
Comita, G. W., 15133
Conroy, D. A., 15316
Cook, David W., 14716
Coombs, J. F., 14977
Cooper, E. L., 15572
Cooper, W. A., 15457
Coppage, David L., 14549, 15455, 15592
Corliss, Jane, 14407
Cornford, Neri E., 14691
Corning, Raymond V., 14341
Cosenza, Benjamin J., 15150
Costa, Robert R., 15239
Coston, Linda C., 15532
Cotton, Dan, 14675
Courtney, Charles H., 15511
Cousens, B., 15426
Coutant, Charles C., 15554
Cowan, Garry I. McT., 14571
Cowey, C. B., 15044
Cragg-Hine, D., 14787
Crawford, David L., 15552
Cromer, Nancy H., 14462
Cronin, L. Eugene, 15037
Cross, D. G., 14746, 15563
Cross, Ford A., 14764
Crossman, John S., 14359, 15451
Crowley, G. J., 14711, 14771, 15571
Crumpton, Joe, 14667
Cuinat, R., 14904
Cullen, M. C., 14621
Culley, Dudley, D., Jr., 15534
Cullimore, D. R., 15083
Cumming, Kenneth B., 14336, 15507, 15520
Cummings, T. Edwin, 14247
Cummins, Kenneth W., 15239
Cushing, C. E., 14696
Cutkomp, L. K., 14552, 15108
Cvancara, Victor A., 14569
Czeczuga, B., 14792

Dadikyan, M. G., 15221
Dahlberg, M. L., 14287
Dahlberg, Michael D., 14986, 15590
Dalforno, S., 14853
Dandy, J. W. T., 14996
Danilenko, T. P., 14523
Darlington, Robert W., 14862
Davidenko, S. I., 14521
Davis, C. William, 14817
Davis, Clarence W., 14985
Davis, J., 14337
Davis, J. C., 15039
Davis, James R., 14453, 15524
Davis, John C., 14609
Davis, Paul W., 14567
Davis, Robert M., 14894

Davisson, Muriel Trask, 15262
Davy, F. B., 15541
Davydov, O. N., 14518
Dawley, Earl M., 14408
Dawson, C. E., 14670
Dawson, Verdel K., 14734
Deacon, James E., 15574
Dechtiar, Alex O., 15146, 15322
de Groot, S. J., 15123
Degurse, Paul E., 14585
De Kinkelin, P., 15107
De la Bretonne, Larry, Jr., 15535
DeMont, David J., 15506
Demory, Robert L., 14230, 14942
Demski, Leo S., 14557
Denisova, A. V., 14932
Dennison, Samuel G., 15584
Denton, E. J., 14473, 14513
Derksen, A. J., 14291
Derr, S. Krogh, 15185
Desaiah, D., 15108
Deutsch, Maurice, 14626
de Vlaming, Victor L., 14789, 14813
DeWilde, Mary Anne, 14788
Dexter, Roger P., 15559
DeYoung, Alice, 15008
Dias, Robert K., 15585
Dias, James K., 15585
Dickson, Kenneth L., 14359, 14906, 15451, 15550
DiDonato, G. S., 15376
Dill, Lawrence M., 14899
Dill, P. A., 14501
Dimmentman, A. M., 15484
Dimond, J. B., 14976
Dingle, J. R., 14290
Disteche, M., 14998
D'Itri, Frank M., 14256
Dixon, Gordon H., 14466, 14467, 14778, 15449
Dixon, J. K., 15015
Dockray, Graham J., 14809
Doloshitskiĭ, S. L., 14401
Dominy, C. L., 14302
Donaldson, Edward M., 15028, 15217
Donaldson, Lauren R., 15576
Dooley, James K., 15366
Dorris, Troy C., 15236
Doty, Maxwell S., 14793
Douglas, John, 14727
Dovel, William L., 15046
Downing, Elaine P., 15032
Drucker, Benson, 14649
Ducharme, L. J. Andre, 15601
Duchrow, Richard M., 14449
Duedall, I. W., 14770
Duffy, J. R., 14511
Dugas, Ronald J., 14412
Duke, Thomas W., 14586, 15455
Dukes, George H., Jr., 14573
Dumas, Richard F., 14700
Dunbar, Clarence E., 14693
Duncan, Richard N., 14366
Dunson, William A., 14810
Dupree, Harry K., 14468
Dyachuk, I. Ye., 14522
Dysart, Douglas K., 14295

Eales, J. G., 14803, 15379
Earnest, Russell D., 14945
Eaton, John G., 14972
Eaton, Stephen W., 15311, 15368
Ebel, Wesley J., 14408
Echelle, Alice F., 15112, 15397
Echelle, Anthony, 14756, 15112, 15397
Eddy, F. B., 15048
Edmondson, W. T., 15281
Edmunds, Philip H., 14243, 14936
Edwards, D. J., 14264
Edwards, R. R. C., 14563, 15290
Egusa, Syuzo, 14837
Ehrenberg, John E., 14499
Ehrlich, K. F., 15045
Eisler, Ronald, 14492, 15165
Elder, J. H., 14692
Ellefson, Paul V., 14460, 14461
Ellender, R. D., 15381
Elliot, George V., 15465
Elliott, J. M., 14907
Elliott, Joseph W., 15302
Ellis, James E., 14956
Elrod, Joseph H., 14457
Elson, P. F., 14511, 15602
Engel, Sandy, 15548
Engelbert, Vibeke E., 14626
England, Russell H., 15507
Engstrom-Heg, Robert, 14371
Ennis, G. P., 15155
Eppenberger, H. M., 15359
Erickson, Kim E., 15519
Erickson, S. J., 15166
Erikson, Lars-Ove, 15312
Erman, Don C., 15190
Ervin, Joseph L., 15581
Eslami, A. H., 15315
Espinosa, Lawrence R., 14940
Etnier, David A., 15169
Evans, D. H., 15360
Evans, Dale R., 14271
Evans, David O., 15623
Evans, Douglas H., 14935
Evans, E. Edward, 14468
Evelyn, T. P. T., 14610
Evenhuis, B. L., 15284
Everest, F. H., 15038
Everhart, W. Harry, 14443, 14449

Fabacher, David L., 14533, 15127
Fabian, B. C., 14798
Fahmy, Fahmy K., 15395
Fairbanks, Deborah, 14869
Faktorovich, K. A., 14965

Fallaux, E. M., 14635
Falls, C. Paul, 14751
FAO of the UN, 14273, 14305, 14955, 15042, 15164, 15271, 15277, 15278, 15420
Farley, Timothy C., 14420
Farr, Winston E., 15199
Farris, D. A., 15045
Fast, Arlo W., 14256
Fatora, Joseph R., 14687
Fearnhead, E. A., 14798
Fedoseev, P. N., 14432
Feldmeth, C. Robert, 15633
Fellman, J. H., 14416
Fenderson, Owen C., 14895
Ferguson, R. G., 14291
Fernando, C. H., 14477
Figueira, A. J. G., 14311
Filipsson, Olof, 15161
Fimreite, N., 14593
Finlayson, B. J., 14498
Finlayson, D. M., 15290
Finn, J. Peter, 14267
Fisher, Nicholas S., 14967
Fisher, Paul B., 14785
Fitch, John E., 15468, 15469, 15632
Fitzgerald, George P., 14623
Fitzmaurice, P., 15043
Fitzmaurice, Patrick, 15479
Flain, M., 15286, 15313, 15387, 15388
Flerov, B. A., 14517
Fletcher, G. L., 15111, 15539
Florinskaya, A. A., 14951
Focant, B., 14998
Fontenot, Bennie J., Jr., 14412, 15027
Forney, David L., 15095
Forney, John L., 14455
Forrest, A., 15203
Forrester, C. R., 15154
Fortin, R., 15255
Fowler, Laurie G., 15088, 15302
Frantsi, C., 14246
Fraser, J. M., 15076, 15352
Freeman, Robert A., 14443
Frey, John E., 14664
Frisbie, Charles M., 15320
Fromm, P. O., 14882
Fry, F. E. J., 15335, 15422
Fryer, J. L., 14541, 14703, 15419
Fujihara, M. P., 14495, 14758, 15081
Fujita, T. S., 14416
Fukami, Jun-Ichi, 14279
Fukunaga, Kazuo, 14279
Fuller, G. C., 14905
Fulton, John, 15431
Funk, James D., 15028
Gaidry, Wilson J., 14436
Gaines, John L., Jr., 15516
Galasun, P. T., 14530
Galat, David L., 14712
Gale, William F., 14374
Gallepp, George W., 15588
Gal'tsova, V. V., 14927
Gard, Richard, 15582, 15583
Gardner, George R., 15168
Gardner, Linda, 14608
Garriott, David D., 14660
Garrison, R. L., 15419
Gast, Marion H., 15611
Gayduk, V. V., 14516
Gee, John H., 15074, 15153, 15536
Gee, Phyllis A., 14625
Geiger, W., 15331
Gensler, P. J., 15030, 15541
Gentile, J. H., 15166
Georgacakis, E., 15363
Georgiev, George S., 15114
Gerasimchuk, S. I., 14381
Gerking, Shelby D., 15209
Germann, Jerome F., 15522
Getchell, A. S., 14976
Ghelardi, R. J., 14969
Ghittino, P., 14853, 14889, 15305, 15306
Gibbons, George O., 15097
Gibbons, J. Whitfield, 15095
Gibbons, John R. H., 15536
Gibson, David I., 14781
Gibson, George R., Jr., 14545
Gibson, H. R., 15186
Gibson, James R., 14898
Gift, J. J., 15459
Giger, Richard D., 14774
Gilchrist, J. R. S., 15307
Gilderhus, Philip A., 15079
Gill, Robert L., 15090
Gillespie, D. C., 14766, 15428, 15430
Gilmour, R. Stewart, 15449
Giovenco, Silvia, 14694
Girardi, F., 14312
Girsa, I. I., 14875
Gjedrem, Trygve, 15142
Gleyzer, S. I., 15231
Glydenholm, A. O., 14266
Godwin, Don S., 14677
Goldspink, C. R., 14260
Goncharov, G. D., 14428, 15003, 15093
Goodman, Joel H., 15298
Goodnight, W. H., 14458
Goodyear, C. Phillip, 15195, 15245, 15595
Gorbach, E. I., 14429
Gordon, M. S., 15063
Gordy, Herbert R., 14651
Gorlin, E., 14597
Gorodnichiy, A. Ye., 14911

Goryczko, Krzysztof, 15246, 15247, 15248
Goryunova, A. I., 14385
Gosh, R. I., 14520
Goswami, Shashi V., 15217
Grabda, Jadwiga, 15139
Grachev, L. Ye., 15113, 15229
Gráham, Joseph J., 14984, 14985
Grainger, E. H., 14311
Grant, George C., 14690
Gray, D. Leroy, 14677
Gray, John S., 14685
Green, David M., Jr., 15196
Greene, George N., 14342, 15513
Greenland, Donald C., 15090
Griffith, J. S., Jr., 15145
Griffiths, J. S., 15144
Grimaldi, Ettore, 15333, 15346
Grimås, Ulf, 15336, 15348
Grinstead, Bobby G., 14678
Grishchenko, L. I., 15439
Griswold, Bernard L., 15189
Gritsenko, O. F., 15228
Gromov, M. A., 14538
Grover, Charles A., 15470
Gruchy, I. M., 14593
Gruendling, G. K., 15134
Gunning, Gerald E., 14357
Gurova, G. V., 15125
Gutenmann, Walter H., 15132, 15538
Guthrie, James F., 14547, 15201, 15598
Gutveyb, L. G., 14527
Gutwirth, E., 14597
Gzhegotskiĭ, M. I., 14401

Haaker, Peter L., 15467
Haastein, T., 14644
Hackney, Peter A., 14326, 14683
Hagen, D. W., 15473
Hagenmaier, H. E., 15390
Hagiya, Koichi, 14636
Haider, Gerhard, 15060
Haight, R. E., 15425
Haines, Terry A., 15581
Hakala, Ilpo, 14822
Hale, John G., 15589
Hall, Ann Bowman, 14284
Hall, Charles A. S., 14251
Hall, Millard W., 15026
Hallowitz, Robert A., 14557
Halsband, Egon, 14479
Halsband, Inge, 14479
Halver, John E., 15369
Hamai, Ikuso, 14827
Hamm, R., 14999, 15012
Hamoir, G., 14998
Hanek, George, 14477
Hansen, David J., 15188
Hansen, Edward A., 14589
Hansen, Martin J., 15418
Hanson, Lee H., 15089
Hanyu, Isao, 14831, 14832
Hara, Takeshi, 14840
Hara, Toshiaki J., 15543
Hardy, R., 15128
Harman, Paul D., 14680
Harper, Jack L., 14351, 15518, 15519
Harris, Earl J., 15538
Hart, Larry, 15528
Hartman, G. F., 14631
Hartman, W. L., 15326, 15345
Harvey, H. H., 14977, 15204, 15615
Hasanen, Erkki, 14818
Hashagen, Kenneth A., Jr., 15464
Hasler, Arthur D., 15176, 15427
Hassan, James E., 15032
Hastings, Robert W., 14485
Hastings, W. H., 14702
Hatfield, C. T., 15029, 15151
Hawkins, Rosemary I., 15202
Hayashi, Seiichi, 14846
Healey, M. C., 14944, 15082
Heard, Richard W., 15590
Heard, William R., 15178
Heath, Alan G., 14884
Heaton, E. K., 15041
Hebert, Houston F., 14412
Heidinger, Roy C., 14360, 14439, 15099
Heitmuller, P. T., 14578, 15104
Heland, M., 14901, 14903
Henderson, C., 15213
Henry, Kenneth A., 14228, 14991
Henson, E. B., 14250
Hergenrader, G. L., 14454
Heritage, G. D., 14825
Herman, Roger Lee, 14693, 15077
Herman, Sidney S., 15040
Herricks, Edwin E., 14359, 15295
Herring, Jack, 14675
Hesselberg, R. J., 15110
Hestand, R. S., III, 15457
Hettler, William F., Jr., 15532
Heyl, Henry L., 15149
Hiatt, James L., 14555
Hibiya, Takashi, 14831, 14832, 14840
Hicks, Don, 15519
Hill, Loren G., 14791, 15397
Hill, Thomas K., 14656
Hiller, Jacob M., 14376
Hilliard, D. K., 14629
Hilsenhoff, William L., 14962
Hines, J. A., 14290
Hines, R., 14320
Hinton, David E., 15257
Hirano, Katumi, 14835
Hledin, R. V., 14294
Hoag, Stephen H., 14988
Hobson, Edmund S., 15490
Hochachka, P. W., 14415, 14480
Hodges, John W., 15627
Hodgins, Harold O., 14987, 15587

Hodgkiss, W., 14601
Hoffman, Carl E., 14331
Hoffman, Glenn L., 14471
Hogan, James W., 14447, 15101, 15575
Höglund, Lars B., 15159, 15160
Hokanson, Kenneth E. F., 15612
Holcomb, Dennis, 15526
Holder, Daniel R., 14684
Holeton, G. F., 15049
Holliday, F. G. T., 14784
Holmes, Donald W., 15564
Holmgren, S. K., 14762
Holsworth, W. N., 14593
Holt, G., 14644
Holz, Delmar D., 15575
Hook, James T., 15095
Hooper, Gerald R., 14343, 14683
Hoopes, David T., 14992
Hopkins, C. L., 15382
Horak, Donald L., 15424, 15560
Horowitz, Jordan J., 14952
Horrall, R. M., 15427
Horton, H. F., 14979
Hoskins, Gary E., 14601
Hoss, D. E., 14588, 15532
Houde, Edward D., 14268, 15318
Houston, Arthur H., 14788, 15542
Hoyle, R. J., 15539
Hoyt, Robert D., 14484, 15523
Hubbard, J. D., 15560
Hubbs, Clark, 14426, 14438, 14482 14750, 15112
Huckins, James N., 14887
Hudson, Patrick L., 14655
Hughes, Janice S., 14669
Huish, Melvin T., 14708
Huisman, E. A., 15106
Hulth, L., 14639, 15109
Humphries, Earl T., 15520
Hungate, F. P., 15081
Hunn, Joseph B., 15091
Hunt, P. C., 15289, 15355, 15367
Hunt, Robert L., 14306
Hunter, G. G., 14358
Hunter, John R., 15492
Huntsman, G. R., 15180
Hurlbert, Stuart H., 14869, 15472
Hurley, Donal A., 14713, 15258 15353
Hutchison, James A., 14486

Igarashi, Hisanao, 14829
Ikeda, Shizunori, 14841, 14849, 14850
Il'in, V. Ye., 14388
Imura, Koji, 14854
Inglis, A., 15213
Inland Fisheries Trust, Inc., 15163
International Pacific Salmon Fisheries Commission, 15372
Isaacs, John D., 15499
Isaia, J., 15354
Itazawa, Yasuo, 14838
Ito, Jun, 14982
Ivankov, V. N., 15224
Ivanov, A. P., 15453
Ivanyukov, N. G., 14526

Jacquest, W. L., 15475
Jahn, Lawrence A., 15179
Jamsen, Gale C., 14460, 14461, 15385
Janicki, Ralph H., 14508
Jarman, Ron, 14351, 15518
Jasper, Robert L., 15184
Jefferies, D. F., 14474
Jelley, Elizabeth, 15626
Jenkins, Robert E., 14643
Jenkins, Thomas M., Jr., 14240, 15465
Jensen, Alvin L., 14366, 14880, 15547
Jensen, Buddy L., 14934
Jensen, Howard E., 14229
Jernelöv, Arne, 14861
Jesse, John H., 14352
Jessop, B. M., 15218
Jester, Douglas B., 14934
Johansen, P. H., 15151
Johansson, Rolf G., 15059
Johnson, Allyn G., 14987
Johnson, B. Thomas, 15299
Johnson, Donald W., 14749
Johnson, G. V., 15364
Johnson, J. L., 15110
Johnson, L., 15349
Johnson, L. G., 15212
Johnson, Leon D., 14397
Johnson, Lionel, 15328
Johnson, M. G., 14753, 14754, 14755
Johnson, Paul W., 14793
Johnson, R. P., 15016
Johnson, Ronald P., 15018
Johnson, Sven I., 14699
Johnson, W. L., 15213
Johnston, James H., 15551
Jolicoeur, Pierre, 15620
Jonas, R. E. E., 14239, 14971
Jones, Albert C., 14983
Jones, Albert R., 14286
Jones, Barry C., 15614
Jones, Bernard R., 15612
Jones, David R., 14490
Jones, J. W., 15289, 15355, 15367
Jones, James H., 14448
Jones, Robert A., 14293
Jones, S., 14645
Joseph, Edwin B., 14890, 15380
Joy, James, E., 14811, 15323
June, Fred C., 15489

Kabata, Z., 14603, 15426
Kaesler, Roger L., 14456
Kalal, L., 14587

Kalmijn, A. J., 14487
Kanazawa, Akio, 15011
Kanid'ev, A. N., 14381
Kanno, Yasuji, 14827
Kapoor, N. N., 15293
Kardos, Larry P., 15311, 15368
Kariya, Teiji, 14839
Karpevich, A. F., 14394
Karuppannan, N. V., 14504
Kasahara, Shogoro, 15067
Kashiwada, Ken-ichi, 15011
Katayama, Teruhisa, 15010
Katz, E., 14597
Kawai, Akira, 14855, 14856, 14858
Kawai, Shin-ichiro, 14841
Kawazu, Kazuyoshi, 14637
Kay, Wendy, 15303
Kaya, Calvin M., 15176
Kazakov, R. V., 14396
Kazlauskene, O. P., 14386, 14863, 15407
Keenleyside, Miles H. A., 14802, 15200
Keith, J. A., 14593
Keith, William E., 14349, 14666
Keleher, J. J., 15330
Keller, Walter T., 15565
Kelso, J. R. M., 15429, 15621
Kemp, H. T., 15300
Kemp, P. H., 14379, 14380
Kendall, Michael W., 15257
Kennedy, H. D., 15610
Kennedy, Michael, 15043, 15479
Kennedy, O. D., 14648
Kennedy, V. S., 14292
Kennedy, W. A., 14969, 15086
Kepshire, Bernard M., Jr., 14650
Kerby, Jerome Howard, 14375, 14459
Kerce, King E., 14661
Kerstetter, Theodore H., 14779
Kesner, William D., 15463
Kevern, Niles R., 14698
Khalturin, D. K., 14912
Khan, M. A. Q., 15363
Khan, R. A., 15393
Kharitonova, N. N., 14743, 14926
Khatiby, Sh., 15315
Khobot'ev, V. G., 15143
Kidd, D. E., 15364
Kihlstrom, J. E., 14639, 15109
Kikuchi, Takahiko, 15270
Kilambi, Raj. V., 14324, 14327, 14331
Kimura, Makoto, 15498
Kimura, Shigeru, 14636
Kinter, William B., 14508
Kionka, B. C., 14768
Kipling, Charlotte, 15337
Kirschner, Leonard B., 14779
Kislyakov, Yu. Ya., 14425, 14430
Kitahara, Tadashi, 15442
Kitchin, S. E., 14562
Kittelsen, A., 14981
Klawe, Witold L., 14645
Kleerekoper, H., 15030, 15182, 15541
Kleinert, Stanton J., 14585
Klement, Alfred W., Jr., 15025
Klussmann, W. G., 14347
Knight, Lee H., 14363
Knuckes, Joseph L., 15406
Kobayashi, Shozo, 14839
Koch, R. B., 14552, 15108
Kochsiek, Kenneth A., 14752
Koeman, J. H., 15106
Kohler, A. C., 14498
Koivo, A. J., 14968
Kokhanova, G. D., 14921
Kolehmainen, Seppo E., 14340
Kolosova, L. V., 15143
Kolot, L. I., 15485
Kolyushev, A. I., 15222
Komarova, T. I., 15410
Konchin, V. V., 14873
Kono, Hideo, 14836
Konovalov, S. M., 14388
Konstantinova, N. A., 15234
Koo, Ted S. Y., 14891, 15580
Kooyman, A. H., 14238
Korniyenko, G. S., 14871
Korotkevich, O. S., 14776
Korovina, V. M., 14919
Koshinsky, Gordon D., 15252, 15365, 15392
Koski, K. V., 15272
Kosyreva, R. Ya., 15453
Kott, E., 14595
Kottcamp, Glenn M., 15600
Kozlov, Yu. P., 15235
Kozlowski, Feliks, 14617
Krakatitsa, V. V., 14920
Kramer, Robert H., 15474
Krantz, George E., 14891
Krasnov, S. K., 15125, 15609
Kriete, William H., Jr., 14690
Kritsky, D. C., 15398
Kroger, R. I., 15201
Kroger, Richard L., 14547, 15598
Krupauer, V., 14736, 15017
Kubota, Minoru, 14636
Kudentsova, R. A., 15403
Kudrinskaya, O. I., 14528
Kuhns, W. J., 14300
Kulemin, A. A., 14383
Kutty, M. N., 14504
Kuznetsov, V. A., 14866

LaBar, George W., 14729
Lachner, Ernest A., 14643
Lackie, N. F. 15167
Lackey, Robert T., 14441, 15564
Lacroix, G., 14299
Laflin, Bonny Dale, 15533

Lahav, M., 14319, 15570
Lahman, M., 15005
LaLanne, John J., 14634
Lammert, H., 15009
Land, F. R. S., 14513
Land, M. F., 14513
Lann, Hans, 14861
Lanse, Roger I., 15051, 15069
Lantz, Richard L., 14540
Lanza, Guy R., 14773
Lapi, L. A., 14605
Lapin, Yu. Ye., 14387
Laptev, V. I., 15131
Larkin, P. A., 14599
LaRoche, Gilles, 15165
Larsen, C. M., 14628
Larson, Gary Lee, 15616
Laser, K. D., 14580
Lasker, Reuben, 14272, 14814, 15494
Latapie, Walter,R., 14436
Latta, W. C., 15287, 15421
Lau, Y. C., 14239
Lauman, Jim E., 15549
Laurence, Geoffrey C., 14607, 14786
Laurent, P. J., 15342
Law, Duncan K., 15552
Lawrie, A. H., 15332
Lazareva, L. P., 14531
Lea, Robert N., 14816, 15632
Leatherland, J. F., 15358
Lebedeva, G. D., 15130
Lebedeva, M. N., 14527
Lebedinskiĭ, N. A., 15441
LeBrasseur, R. J., 14648
LeCren, E. D., 15337
Leduc, Gerard, 15394
Lee, D. J., 15117, 15118, 15120
Lee, Young W., 15250
Legeza, M. I., 14914
Leggett, William C., 14293, 15487, 15596
Lehmkuhl, D. M., 15540
Leiby, P. D., 15398
Leith, D. A., 14703
Lembi, C. A., 14692
Leonenko, Ye. N., 15483
Lesnikov, L. A., 14427
Leteux, Frank, 14706
LeTurdu, Y., 15107
Lewis, C. W., 14588
Lewis, D. H., 15087, 15517
Lewis, Robert M., 14406, 14651
Lewis, Steven A., 14660
Lewis, Sue D., 14442, 15510
Lewis, U. J., 15494
Lewis, William M., 14439, 14442, 15099
Leyendecker, W. E., 14253
Lezina, A. N., 14532
Li, M. F., 15254
Liang, J. K., 14688, 14806
Liao, Paul B., 14369
Lighthill, M. J., 14878
Lillelund, Kurt, 14272
Lind, O. T., 14960
Lindahl, P. E., 14860
Lindberg, G. U., 14910
Lindsey, C. C., 14493
Lindsey, J. K., 15264
Lisk, D. J., 14550, 14577, 14618, 14620, 15132, 15538
Liston, Charles R., 14331
Lloyd, R., 14282
Lock, J. T., 14347
Loeffler, Clarence A., 15047
Loftus, Kenneth H., 15283, 15351
Lom, Jiri, 14471
Longridge, Jerry L., 14962
Lopukhina, A. M., 15001
Louder, Darrell E., 14453, 14658, 15502
Love, Richard H., 14402
Lovegrove, R. I., 14310
Lovell, R. T., 14638, 14688, 14806, 15509
Lovett, Raymond J., 14900, 15538
Ludke, J. Larry, 14898
Lugaski, Thomas, 15529
Lugovaya, T. V., 14929
Lukonina, N. K., 14394
Luk'yanenko, V. I., 15121
Lumare, F., 14888
Lundberg, C., 14639
Luquet, P., 15073
Lusk, Christina I., 14898
Lutz, Peter L., 14807, 14808, 15414, 15415
Lyakhnovich, V. P., 15483
Lyashenko, A. F., 14526
Lyford, J. H., Jr., 15198

MacCrimmon, Hugh R., 15384
Macek, Kenneth J., 15575
MacFarlane, A., 14784
Machniak, Kazimierz, 15153
Mackie, G. L., 14502
Mackie, P. R., 15128
Madison, D. M., 15427
Maetz, J., 14509, 15360, 15362
Magnin, E., 15255
Magnuson, John J., 15548, 15588, 15607
Mahnken, Conrad V. W., 14270
Maitland, Peter S., 14576, 15339
Major, Richard L., 14653
Makeyeva, A. P., 14865
Makkoveyeva, I. I., 14383
Maksimov, V. A., 14384
Maksimova, Ye. M., 15484
Maletto, S., 14889
Maloney, T. E., 15166
Malsberger, Richard G., 15040

Malyusz, M., 15058
Mann, Hans, 14777, 14954, 15007, 15569
Manohar, S. V., 14503
Manooch, Charles S., III, 14333, 15531
Mansueti, Alice J., 15037
Marcy, Barton C., 14245, 15375
Marek, M., 14598
Markert, J. R., 14974
Markiewicz, Franciszek, 15321
Marking, Leif L., 14592, 14707, 14734, 15591
Marshall, T. Lawrence, 15018
Martin, F. Douglas, 14732
Martin, J. Mayo, 14677
Martin, N. V., 15335
Martynyuk, N. V., 14401
Marushige, Keiji, 14467
Mashneva, N. I., 15405
Masic, D., 14999, 15012
Maslennikova, N. V., 14872
Maslowska, Ewa, 14997
Maslyukova, N. G., 15437
Massaro, Edward J., 14885
Masuda, Isao, 14834
Matey, V. E., 14515
Mather, Frank J., III, 14983
Mathis, William P., 14677
Mathisen, Ole A., 14404
Mathur, Dilip, 14663, 14877
Matis, J. H., 15030
Matsuda, Yoshiaki, 14363
Matsumoto, Walter M., 14645
Mauck, Paul E., 14662, 14689
Mauck, Wilbur L., 14234, 15603
Mawdesley-Thomas, Lionel E., 14414, 15202
May, Bruce E., 14441
Mayer, F. L., Jr., 15400, 15603
Mayerle, Joan A., 14883
Mazmanidi, N. D., 14431, 15125, 15609
McAllister, Don E., 15620
McAllister, William A., Jr., 15603
McArn, G. E., 14494
McCain, B. B., 14541
McCann, A., 15083
McCann, John A., 15184
McCarraher, D. B., 14769, 15604
McCarthy, D. H., 15316
McCarthy, James J., 14990
McCartney, Thomas J., 15565
McCaskill, Matt L., 15197
McCauley, R. W., 14765
McCleave, James D., 14729
McClendon, Emmitt L., 15187
McClue, Mary E., 15450
McCombie, A. M., 15353
McConnell, Robert J., 15119
McCormack, Jean C., 15337
McCormick, J. Howard, 14252, 15612
McCosker, John E., 14767
McDermott, L. A., 14506, 14963, 15389
McDiffett, Wayne F., 15240
McGill, A. S., 15128
McGuinness, E. T., 14621
McIlwain, T. D., 15192
McKenzie, Michael D., 15177
McKeown, B. A., 15148
McKone, Colin E., 14577, 14618
McLain, Alberton L., 15344
McLain, L. R., 14780, 15050, 15080
McNabb, Roger A., 14558
McNatt, Randy M., 15396
McNeil, William J., 14650
McSheffrey, H. M., 14605
Meade, T. G., 14790
Mearns, A. J., 15458
Mecham, John A., 14558
Mehrle, Paul M., 15450
Mel'nichuk, G. L., 14525
Menshutkin, V. V., 14425, 14430, 14864, 14924
Mensinger, Gary, 14662, 14672, 14689, 15519
Menzel, Bruce W., 15196
Merline, Margaret, 14312
Merna, James W., 15181
Merriner, John V., 14437, 15628
Merritt, Robert B., 15267
Messieh, S. N., 14237, 15613
Metcalf, F. A., 15356
Miaczynski, Tadeusz Bory, 15321
Metcalf, Robert A., 14799
Metcalf, Robert L., 14799
Metroka, C. E., 14300
Meyer, Fred P., 14677, 14706
Meyers, S. P., 14702
Micha, J.-C., 14902
Michewicz, Jane E., 15065
Michigan Dept. of Natural Resources, 15606
Mikryakov, V. R., 14428
Milanesi, Albert A., 15055, 15056
Miles, H. M., 15458
Millard, Timothy J., 15384
Millemann, Raymond E., 14572
Miller, Charles W., 14578
Miller, D. E., 15440
Miller, Grover C., 15061, 15399
Miller, J. P., 14337
Miller, Lee W., 14939, 14941
Miller, Robert Rush, 15172, 15629
Miller, Roy W., 14710, 15506
Miller, Rudolph J., 14782
Mills, Earl R., 15534
Mills, James G., Jr., 15140
Mills, Paul R., 15197
Minaur, J., 14261
Minckley, W. L., 14749, 15072
Mitchell, R. B., 15572

Mitsui, Tetsuo, 14637
Moav, R., 15005
Mobrand, Lars M., 15452
Mock, Woodrow R., 14436
Moe, Martin A., Jr., 14937
Mohamed, M. Peer, 14504
Monakov, A. V., 15215
Mondl, Mark C., 15237
Money, Vida G., 15216
Monk, Bruce H., 14408
Moodie, G. E. E., 15473
Moodie, P. F., 15473
Moody, Mark, 15261
Moon, Thomas W., 14415, 14480
Moore, Charles J., 15320
Moore, J. W., 15553
Moore, K. D., 14703
Moore, Keith L., 14625
Moose, Paul H., 14257, 14499
Moravec, F., 14606
Morgan, Eric L., 14276, 15578
Morgan, Raymond P., II, 14891
Morgenthaler, L. P., 14719
Morita, Shou, 15442
Morley, R. B., 15028
Moroz, I. Ye., 15230
Morre, D. J., 14692
Morris, D., 14562
Morris, R. L., 15212
Morrison, G. E., 14980
Morrison, Robert, 14752
Moser, H. Geoffrey, 15495
Mosher, Kenneth H., 14652
Moskalev, A. A., 15454
Mosser, Jerry L., 14967
Motais, R., 15354
Movchan, N. A., 14776
Moyle, Peter B., 15600
Muir, Barry S., 14233, 15035
Mukhachev, I. S., 14917
Mulla, Mir S., 15472
Munro, A. L. S., 14783
Muntz, W. R. A., 14473
Murachi, Shiro, 15066
Murai, Takeshi, 15097
Murphey, Ernest W., 14772
Murphy, Garth I., 15491
Murphy, John, 15015
Murphy, Josette Vidril, 14476
Murphy, Philip G., 14476
Murray, D., 14241
Muzykovskiĭ, A. M., 14400, 15438

Nagahisa, Eizo, 14820
Nagai, Masanori, 14849, 14850
Nakamura, Nakaroku, 15067
Nakatani, R. E., 14495, 14758
Nanba, Kenjo, 14839
Napravnik, J., 14587
Narasimhan, P. V., 14265
Narayanan, M., 14504
Narf, Richard P., 14962
Nash, F. W., 15264
Nazarenko, K. T., 14519
Nebeker, Alan V., 14378
Nechaeva, N. L., 15453
Neff, S. E., 15523
Neff, W. H., 15572
Negele, R.-D., 15275
Negonovskaya, I. T., 15210
Neill, William, 15558, 15607
Nelson, Joseph S., 15371, 15419
Nelson, Martin O., 14257
Neproshin, A. Yu., 14399
Nepszy, S. J., 15352
Nerrie, Brian, 14581
Neuhold, J. M., 15400
N. Y, State College of Agriculture, Cornell Univ., 15340
Newman, Joseph T., Jr., 15150
Newton, C. E., 15457
Nicholson, B. L., 14615
Nicholson, William R., 14405, 14451, 15446
Nickerson, Max A., 14486
Nicol, J. A. C., 15062
Nielson, N. O., 14267
Nigrelli, R. F., 14300, 14767
Niimi, A. J., 15035, 15304
Nikolaev, A. S., 14399
Nikol'skii, G. V., 14742
Nilsson, Nils-Arvid, 15161, 15325, 15336 15348
Nimmo, DelWayne R., 15104
Niwa, Hiroshi, 14844
Noble, Robert W., 15008
Northcote, T. G., 14496, 15259, 15341
Northmore, D. P. M., 14473
Nose, Yukio, 14836
Novotny, Anthony J., 14270
Novotny, Donald W., 14398
Novy, James R., 15181
Nümann, W., 15338, 15346
Nuorteva, Pekka, 14818
Nuzzi, Robert, 15138
Nyman, Lennart, 15162
Nyman, O. L., 14566, 15075

O'Connell, Charles P., 15497
O'Connor, Joel S., 14613
Odense, P. H., 15036
Ogawa, Akira, 14829
Oglesby, Ray T., 15334
Oguri, Mikio, 14848
Okada, Shun, 14824
Olla, Bori L., 14543
Olmsted, Larry, 14324
Olson, K. R., 14882
Olson, P. A., 14758
Olson, P. R., 15573
Ooshiro, Zentaro, 14833, 14851, 14859
O'Rear, Robert Stephen, 14345

Orlov, O. Yu., 15484
Orlowski, Stanley J., 15040
Orsi, James J., 14423
Osadchiĭ, V. D., 14432
Oseid, D. M., 15314
Ota, Toru, 14828
Ott, A. G., 14979
Ovchynnyk, Michael M., 14318
Overbeck, R. C., 15300
Owen, John B., 14483, 15284, 15440
Owen, J. M., 15044
Owen, T. G., 14565

Packer, Randall K., 14810
Page, Jimmy W., 14363
Page-Jones, R. M., 15122
Pakkala, Irene S., 15538
Palmer, T. N., 15211
Panchenko, S. M., 14926
Panov, D. A., 14744
Panyushkin, Yu. A., 15486
Paperna, I., 14319, 15562
Pardue, Garland B., 14656
Park, Donn L., 15199
Parker, J. C., 15404
Parker, John D, 14470
Parker, R. O., Jr., 14957
Parker, Robert R., 14600, 14982
Parks, Robert P., 14709
Parrish, James D., 14989
Parrish, Patrick R., 15527
Parrott, Arthur W., 14249
Parsnitskaja, A. I., 14800
Parsons, T. R., 14646
Pasch, R. W., 15198
Patten, Benjamin G., 14507
Patton, Stuart, 15251
Paulik, Gerald J., 14653
Pavlov, A. V., 15227
Payne, R. H., 15203
Peakall, David B., 14900
Pearce, P. A., 14593
Pearcy, William G., 15617
Pearson, William D., 15474
Peden, Alex E., 15154
Pederson, G. L., 15460
Pennsylvania State Univ., 14908
Pennycuick, Linda, 14472
Pentreath, R. J., 14474
Perkinds, E. J., 15307
Perlmutter, Alfred, 14376
Perret, William S., 14412, 14436
Perrin, Carl, 15505
Perry, W. Guthrie, Jr., 14325, 14354, 15512
Persson, Anders, 15160
Peters, Gabriele, 15568
Peters, H. M., 14616
Peters, Nicolaus, 15568
Peterson, C. A., 15398
Peterson, Donald A., 15100
Peterson, G. L., 14794
Petersson, Ake, 15156
Pfeiffer, Peter W., 15533
Phillips, B. F., 15291
Phillips, G. R., 14968
Piavis, George W., 14555
Pickering, Alan D., 14809
Pickering, Quentin H., 15611
Pickford, Grace E., 15494
Pietsch, John P., 15034, 15175
Pigg, Jimmy, 14750
Pike, David J., 14642
Pilcher, K. S., 14541
Pimentel, David, 14717
Piper, Robert G., 15152
Pippy, J. H. C., 15075
Plosila, Daniel S., 15565
Plumb, John A., 14735, 14797, 14812, 15514
Poddubnyy, A. G., 14516
Pollard, Judd F., 14436
Poluhowich, John J., 14709
Polyakov, G. D., 14921
Pond, W. L., 14765
Popchenko, V. I., 14390
Popova, G. V., 14932
Pora, E. A., 14274
Post, George, 14304, 15557
Potash, Milton, 14250
Potter, I. C., 15537, 15630
Potts, W. T. W., 15357
Povoledo, D., 14241
Powers, Dennis A., 15310
Pozzi, G., 14312
Prasher, Janis B., 14361
Prather, E. E., 14344, 14638
Precup, O., 14274
Price, John W., 14465
Priegel, Gordon R., 14317, 14398
Prikhod'ko, T. I., 14924
Pritchard, Hayden N., 15040
Prosser, C. Ladd, 14481
Proto, Daniel, 15031
Pushkar, I. G., 14932

Qadri, S. U., 14502
Quayle, D. B., 14969
Querfeld, C. W., 15062
Querfeld, F. R. S., 15062
Qureshi, M. D., 14294

Rabalais, Francis C., 15237
Rabkin, E. M., 15403
Rachlin, Joseph W., 14785
Rafail, S. Z., 14510, 14551, 14568
Rahrer, J. F., 15332
Rainey, William E., 14356
Ramsey, John S., 15500, 15501
Rand, S., 14896
Randall, D. J., 15058

Ransom, John D., 15236
Rass, T. S., 14910
Rasskazov, V. A., 14800
Rausch, R. L., 14629
Ravagnan, G., 15305
Rawson, Mac V., Jr., 15057
Rawstron, Robert A., 15464
Rawstron, Robert R., 14421, 14435, 14819, 14943
Reed, John K., 15511
Reed, Roger J., 14452
Reeves, J. E., 15376
Reeves, William C., 15522
Regier, Henry A., 15283, 15324, 15351
Rehwoldt, Robert, 14581
Reichenbach-Klinke, H.-H., 15275
Reid, Gerald M., 15377
Reimers, Paul E., 14242
Reinboth, Rudolf, 15435
Reinert, Robert, 14584, 14796, 15256
Reintjes, John W., 14995
Resh, V. H., 15523
Rice, T. R., 15496
Rich, Peter H., 14464
Richards, C. E., 14459
Richards, William J., 14645
Ricker, W. E., 14537, 14612
Riggs, Carl D., 14756
Ringrose, R. C., 14288
Ritchie, Jerry C., 15402
Rizvanov, R. A., 15233
Roberts, B. L., 14879
Roberts, Franklin L., 15559
Roberts, Ronald J., 14783, 14852, 15308
Robins, G. L., 14760, 14761
Robinson, D. G., 14505, 14647
Robinson, John B., 14367
Robison, Henry W., 14782
Robson, D. S., 14994
Rodgers, Charles A., 15064
Rodriguez, Aida, 14448
Rogers, Wilmer A., 14573, 15057, 15243, 15515, 15516
Rogillio, Howard E., 15027
Rohdy, D. D., 14310
Roland, John V., 14336
Romanov, L. M., 15408
Ronald, A. P., 14512
Rooney, Sally C., 15559
Rosen, Moe Wm, 14691
Rosenthal, H., 14795
Ross, A. J., 14705, 15545
Roth, E. S., 14416
Roth, H., 15331
Rothschild, B. J., 14395, 14994 15488
Rowe-Rowe, D. T., 14364
Rubtsov, V. V., 14921
Rucker, Robert R., 14950, 15383
Rudenko, G. P., 15225
Rudy, P. P., 15357
Ruggieri, G. D., 14300
Rusetskaya, Z. N., 15456
Russell, Thomas R., 14468
Ruthven, Jeanne, 14411
Rutledge, William P., 15053
Ryan, K. P., 14879
Ryder, R. A., 15279, 15349
Ryman, Brenda E., 15211
Ryzhova, L. N., 15482

Sabodash, V. M., 14514, 14775
Saddler, J. B., 15272, 15458
Safonov, N. N., 14400
Sage, Martin, 14409, 14561
Saha, Jadu, 15250
Saila, Saul B., 14989
Saito, Takashi, 14834
Sakagawa, Gary T., 15498
Sakata, Kanzo, 14637
Saksena, Vishnu P., 14890, 15318
Sammons, James I., 14243
Samylin, A. F., 14434
Sanders, Herman O., 15129
Sanders, J. E., 14703
Sanders, Marilyn M., 14778
Sandow, Jack Thomas, Jr., 14659
Sano, Tokuo, 14843, 14845
Sapin, M. F., 14920
Sargent, J. R., 15044
Sargent, M., 14692
Sarig, S., 14594, 14598, 15570
Sastry, Akella, 14793
Saunders, J. W., 15602
Saunders, R. L., 15624
Savage, N. L., 15087
Savan, M., 14246
Savina, R. A., 14740
Savitz, Jan, 14280
Scalet, Charles G., 15241
Schaaf, W. E., 15180
Schafer, William E., 15187
Schäperclaus, Wilhelm, 14315
Scheel, J. J., 14266
Scherer, E., 14500
Scherf, E., 15007
Schindler, D. W., 14762, 15133
Schmittou, H. R., 14323
Schneider, David E., 14480
Schneider, James C., 15374
Schneider, Joel F., 14438
Schnick, Rosalie A., 14961
Scholl, A., 15359
Scholl, Russell L., 14619
Schreck, Carl B., 14235
Schrohenloher, Ralph, 14468
Schultz, Vincent, 15025
Schutz, D. C., 15259
Schuyf, A., 15123

Schwanbom, E., 14860
Scott, D. P., 14766
Scott, K. R., 14296, 15430, 15432
Seagran, Harry L., 15256
Seavey, B. D., 15494
Seegrist, Donald W., 15582, 15583
Seehorn, Monte E., 14657
Seki, Nobuo, 14842, 14847
Sekizawa, Yasuharu, 15270
Selgeby, James H., 14403
Shabalina, A. A., 14391
Shafi, Muhammed, 14576
Shannon, Eugene H., 14329
Shapiro, A. P., 14928
Shaposhnikova, G. Kh., 15223
Sharp, H. Bryan, 14438
Sharp, R. W., 14722
Shaw, Derek H., 14566
Shaw, Stanton B., 14815
Shchepkin, V. Ya., 15226
Shcherbina, M. A., 14386, 14863, 15407
Shcherbinin, G. Ya., 14388
Shealy, M. H., Jr., 15219
Shealy, Robert M., 14573
Shearer, W. M., 14783
Shehader, Z. H., 14794
Shih, C.-T., 14311
Shikhshabekov, M. M., 14918
Shimazaki, Kenji, 14826
Shirokova, Ye. L., 14534
Shishido, Takashi, 14279
Shnarevich, I. D., 14930
Shoken, Sasaki, 14418
Shoop, C. T., 14969
Shpet, G. I., 14926
Shubina, T. N., 14392
Shumilov, I. P., 14870
Shumway, Dean L., 14959
Shuttleworth, T. J., 15413
Siebers, D., 14795
Sieburth, John McN., 14793
Siefert, Richard E., 15171
Sikora, Walter B., 15590
Silliman, R. P., 14301
Sills, Joe B., 14680
Simco, Bill A., 14445
Sinclair, Norman R., 14948, 15378
Singh, R. N. P., 15494
Sinnhuber, R. O., 15117, 15118, 15120
Skidmore, J. F., 15296
Skjervold, Harald, 15142
Smigielski, Alphonse S., 15102
Smith, Albert C., 15416
Smith, Allan K., 15549
Smith, Barry W., 14656, 15509
Smith, C. E., 14780
Smith, Cathy A., 15545
Smith, Charlie E., 15152
Smith, Edward J., 15481, 15566
Smith, G. R., 14868
Smith, H. D., 15078
Smith, L. L., 15314
Smith, L. S., 15458
Smith, Lloyd L., Jr., 14450, 15189
Smith, Lynwood S., 14373
Smith, Paul E., 15493
Smith, Stanford H., 15327, 15350, 15412
Smith, Stephen F., 15504
Smith, Wesley E., 15173
Smith, William B., 14348, 15525
Smitherman, R. Oneal, 15500, 15501
Snipes, Robert L., 15257
Snow, Howard E., 14303
Snow, J. R., 14681
Snyder, Diane, 14584
Snyder, George R., 14591, 15119
So, Bernard K. F., 15269
Sokolov, L. I., 14923
Sokolov, P. M., 15437
Sokol'skaya, N. L., 15023
Solomatina, V. D., 14535
Solopova, M. I., 14383
Somkina, N. V., 14529
Sonstegard, Karen S., 14963
Sonstegard, R. A., 14506, 14963, 15389
Sorokin, Constantine, 14463
Sorokin, Yu. I., 14744
Southward, G. Morris, 14727
Spall, Richard D., 14470
Spangler, G. R., 15343, 15353
Sparks, Richard E., 14287, 14906, 15115, 15141, 15544
Speece, R. E., 14253
Spehar, Andrea M., 14881
Spencer, Sam L., 15503
Sprague, J. B., 14511
Spratt, Jerome D., 14946
Stadnyk, Lelyn, 15299
Stalling, David L., 14887, 15064
St. Amant, James A., 14418
Stanley, Jon G., 14440
Starik, S. S., 14930
Starling, Charles C., 15530
Stasko, A. B., 15427
State Fish & Game Depts., National Conservation organizations and the Bureau of Sport Fisheries and Wildlife, 14909
Stauffer, Thomas M., 14726, 15418
Steele, D. H., 14292
Steele, J. H., 15290
Steele, K. L., 15096
Steele, Robert G., 14802
Steffens, Werner, 14316
Stelzer, R., 14795
Stepanova, M. A., 15093
Stephens, K., 14646
Stern, Daniel H., 15105
Stern, Michele S., 15105
Stevens, E. Don, 15084, 15361, 15422

Stewart, Donald, 15256
Stewart, K. W., 15417
Stickney, Robert R., 14362, 14445, 14733, 14892, 15097, 15116
St. John, Leigh, 14550
Stobo, Wayne T., 15193, 15194
Stolbunov, A. K., 14925
Stone, Richard B., 14258
Storr, J. F., 15285
Strand, J. A., 14695
Strawn, Kirk, 14332, 14446
Street, J. C., 15400
Stroganov, N. S., 15143
Studholme, Anne L., 14543
Sugahara, Isao, 14855, 14856, 14858
Sugiyama, Motohiko, 14858
Sukal'skaya, S. Ya., 15405
Sukhanov, V. V., 14928
Sumari, Olli, 14821
Summerfelt, Robert C., 14662, 14665, 15528
Sundararaj, Bangalore I., 14265, 15217
Suppes, V. Charles, 14697
Surber, Eugene W., 14353, 14574
Sutherland, D. B., 14825
Sutherland, Doyle F., 14958
Sutterlin, A., 14896
Sutterlin, N., 14896
Suttkus, Royal D., 14321
Sutton, D. L., 15065
Suzuki, Akira, 15270
Suzuki, Keiko, 15071
Suzuki, Noriyo, 14564
Svobodova, Z., 14281
Swartz, Don F., 14227
Sweeney, Robert A., 15031, 15032, 15033, 15285
Sweet, B. H., 15381
Swingle, Hugh A., 14339
Sykora, J. L., 15481, 15566
Sylvester, J. R., 15266, 15561
Symons, Philip E. K., 14236, 14478, 14763
Synak, M., 15481, 15566
Syrett, Roll F., 14252

Tabata, Mitsuo, 14844
Taber, Charles A., 15103
Tafanelli, R., 14689
Tagatz, Marlin E., 14284
Tajima, Yukiko, 14834
Takahashi, M., 14646, 15066
Takashima, Fumio, 14840
Talbot, G. B., 14699
Tamaoki, Bun-ichi, 15071
Tamura, Tamotsu, 14844, 14857
Tan, Anna L., 15008
Tanaka, Masaru, 15268
Tangen, E. G., 14695
Taniguchi, Akira, 14824
Tarasova, O. M., 14743
Tarplee, William H., Jr., 15502
Tarr, H. L. A., 14608
Tarusov, B. N., 15235
Tarzwell, Clarence M., 15165
Tatum, Walter M., 14326
Taub, Stephen H., 14714
Taylor, Warner G., 14370
Telitchenko, M. M., 14534
Templeton, W. L., 14695
Tenaza, Richard H., 14814
Tennessen, Kenneth J., 14962
Teshima, Shin-ichi, 15011
Thakur, Nirmal K., 15066
Therrien, C. D., 15572
Thomas, Andrew J., 15251
Thomas, Martin L. H., 15626
Thomas Robert E., 15604
Thomerson, Jamie E., 15197
Thompson, Kenneth E., 15549
Thorne, Richard E., 14257, 14497
Thorpe, J. E., 15308
Thorslund, Anders E., 14307, 14308, 14309
Thorson, Kenneth N., 15433
Thunberg, Bruce Einar, 14542
Tibbo, S. N. 14237
Tidd, Wilbur M., 14361
Tilton, R. C., 15015
Timm, T., 15443, 15477, 15478
Timms, A. M., 15182
Tindle, R. C., 14718
Tleuov, R. T., 14389
Toetz, Dale W., 14232, 15238
Toivonen, Jorma, 15280, 15348
Toole, Joe E., 14723
Tovell, P. W. A., 15296
Travkina, G. L., 14393
Traxler, G. S., 15254
Trent, Lee, 14407
Tretiak, D. N., 14238, 15619
Trust, T. J., 14297, 15216, 15260
Tsai, Chu-fa, 14545, 14546, 14731
Tsepkin, Ye. A., 14923
Tsinober, A. B., 15231
Tsuyuki, H., 14512, 15620
Tsuchiya, Haruhiko, 15010
Tsuchiya, Yasuhiko, 14820
Tsuyuki, H., 14759
Tsytsarin, G. V., 14534
Tubb, Richard A., 14361
Tucker, Don, 14564
Tugarina, P. Ya., 15482
Turdakov, A. F., 14867
Turner, Jerry L., 14420, 15579
Turner, Paul R., 14665
Tuunainen, Pekka, 14897
Tyler, A. V., 14757, 15423
Tytler, P., 14784

Uchida, Naoyuki, 14823

Ueyanagi, Shoji, 14645
Umminger, Bruce L, 14553
U. S. Dept. of Interior, Bur. of Commercial Fisheries, 14614
U. S. Dept. of Interior, Bur. of Sport Fish. & Wildl., 15329, 15471
U. S. Office of Water Resources Research, 15020, 15021, 15022
Uskov, I. A., 15409
Uskova, Ye. T., 14521, 15409
Ustimovich, D. A., 14521
Uthe, J. F., 14298, 14590
Utter, Fred M., 14987, 15587
Uyeno, Teruya, 14868

Vanderpuye, C. J., 14579
van Overbeeke, A. P., 15148
Vanstone, W. E., 14294, 14974
Van Thuy, Nguyen, 14464
Varga, Louis P., 14751
Varoujean, Daniel H., 15466
Vasetskiy, S. G., 14382
Vasil'yev, A. S., 15231
Vasil'yeva, N. Ye., 14919
Velsen, F. P. J., 14602
Verigin, B. V., 14417, 14742, 14865
Vermeer, Kees, 15436
Vigliani, E., 15306
Villani, P., 14888
Vladimirov, V. L., 14966
Volkova, L. A., 15232
Von Geldern, C. E., Jr., 14424, 14938
von Limbach, Bruno, 15319
Voronin, F. N., 15456
Voropaev, N. V., 14738
Votintsev, K. K., 14536
Voyer, R. A., 14980
Vrochinskiĭ, K. K., 15136

Wadley, Gerald W., 14295
Waggoner, John P., III, 15633
Wagner, Wilbert C., 14730, 15418
Wahtola, Charles, Jr., 14483, 15284, 15440
Wajdowicz, Zbigniew, 15386
Walburg, Charles H., 15183
Wales, J. H., 15117, 15120
Wali, M. K., 15134
Walker, Charles R., 14225, 14583
Wallace, Dale C., 14544, 14866
Wallace, L., 15294
Waller, Richard, 15192
Waller, William T., 14287, 14462, 14906, 15141, 15244, 15544
Walsh, D. F., 15610, 15575
Walsh, Gerald E., 14578
Walton, Craig P., 14962
Ward, F. J., 15429
Wardle, C. S., 14475, 15480
Ware, D. M., 14973, 15622
Ware, Forrest J., 14671
Wares, Paul G., 14933, 14935
Warner, Kendall, 15555
Warner, Mark C., 14470
Warrinner, J. E., 14337
Washburn, George N., 15577
Wassermann, M., 15007
Watanabe, Takeshi, 14840
Water Resources Research Inst., Oregon State Univ., 15214
Watson, D. G., 14696
Webb, Joseph F., 14683
Webb, P. W., 14488, 14489
Weber, Andrew J., 15502
Wedemeyer, Gary A., 14567, 14978, 15444
Wegener, William, 15526
Weingarten, Warren O., 15597
Weinheimer, Peter F., 14468
Weiss, D. M., 15205, 15309
Welander, Arthur D., 14295
Wellings, S. R., 14494
Wells, LaRue, 15344
Wells, Marion R., 15401
Wendt, Curt, 15336, 15348
Westlake, G. F., 15030
Westman, J. R., 15459
Wetzel, Robert G., 14464, 14548
Wheat, Thomas E., 14953, 15068
White, Charles J., 14436
White, W. J., 15157
Whiteside, B. G., 15396
Whitledge, Terry E., 14990
Whitley, James R., 15373, 15391
Whitney, Richard R., 15487
Whitt, Gregory S., 14481, 14799, 14886, 14952, 14953, 15052, 15054, 15068, 15356
Wieclawski, Franciszek, 15135, 15370
Wiggs, A. J., 14565, 14801
Wigle, Donald T., 14466
Wilamovski, A., 14320
Wildish, D. J., 14498, 15297
Wilhelm, R., 15390
Wilhm, Jerry L., 14752
Wilkens, E. Peter H., 14406, 14651
Willford, Wayne A., 14377
Williams, DeWayne A., 14774
Williams, Ernest H., Jr., 15243
Williams, Hampton M., 14668, 15521
Williams, Roy O., 14947
Willis, D. E. 15265
Willis, James N., 14764
Willson, Harold R., 15472
Wilson, John S., 15580
Wilson, R. C. H., 15625
Wilson, R. M., 15154
Windell, J. T., 14768, 15261, 15560
Winterbourn, M. J., 14358
Withler, F. C., 15028
Witt, Larry A., 14313, 14314

Wohlfarth, G., 15005
Wojdani, A., 15006
Wojno, Tadeusz, 15249
Wojtowicz, M. B., 15036
Wolcott, Michael, 14468
Wolf, Ken, 14335, 14862, 15077
Wolf, Robert S., 14368
Wolfe, D. A., 15496
Wolff, P. V. I. M., 15106
Wollitz, Robert E., 14352
Wood, James W., 15556
Woods, Leon A., Jr., 15462
Woods, R. J., 15542
Woodward, Donald J., 14557
Worthington, R. E., 15041
Wunder, W., 15070
Wurster, Charles F., 14967
Wyatt, Ellis J., 14226
Wyatt, T., 15288

Yada, Toshiaki, 15067
Yakubov, S. M., 15235
Yamada, Juro, 14830
Yamada, Minoru, 14828
Yamada, Umeyoshi, 15002
Yamamori, Kunio, 14831, 14832
Yap, H. H., 14552, 15108
Yarbrough, James D., 15401
Yarzhombek, A. A., 14872
Yashouv, A., 14320, 14596, 15019, 15608
Yasunaga, Yoshinobu, 15445
Yasutake, William T., 15207
Yellayi, Rama R., 14327
Yerger, Ralph W., 14485
Yevich, Paul P., 15168
Yoder, Warren G., 15098
Yone, Yasuo, 14835
Yonezawa, Katsuyuki, 14857
Yongue, William H., Jr., 14410
Yoshima, Howard O., 14269
Yoshino, Timothy P., 15411
Young, A. H., 14784
Young, Diane L., 15240
Young, Roger G., 14550, 14577
Youngs, William D., 15132, 15334, 15538, 15594

Zabik, Matthew J., 15185
Zama, Koichi, 14829
Zaugg, W. S., 14780, 15050, 15080
Zbigniew, Jara, 15321
Zedler, Joy, 14869
Zhiteneva, L. D., 14915
Zhiteneva, T. S., 14922
Zhukinskiy, V. N., 14520
Zillich, John A., 14875
Zillioux, E. J., 15167, 15170
Zitko, V., 14498, 14582, 15602
Zorach, Timothy, 15631
Zubareva, E. L., 14741
Zubenko, V. L., 15234
Zubkova, L. A., 15093
Zweifel, James R., 15497

SUBJECT INDEX FOR VOLUME 17

Age and growth,
amur,
black, in Amur River basin, 14429
white, in Amur River basin, 14429
anchovy,
and sardine larvae in laboratory, effect of food level on, 15318
northern,
age and length in California fishery, 1969-70, 14946
in California fisheries, 14419
barbel in Ourthe River, 14902
bass,
largemouth, evaluation of 3 strains stocked in Alabama ponds, 15503
Roanoke, in North Carolina, 15525
striped,
from winter gillnet catches in Rappahannock River, 14690
X white, in Rappahannock River, Virginia, 14459
bluegill, development and growth thru one year, 15067
bream, European,
growth and fecundity in Polish reservoir, 15276
in Kakhovka Reservoir, USSR, and "Chugunova" paradox, 14522
bullhead, black, population under commercial harvest, 14483
carp,
grass, in Russian fish-farm ponds, 14737
thru vital staining of hard tissues with tetracycline-HCl, calcein and alizarin red S, 15002
catfish, channel,
and food conversion, re photoperiod, 14362
effects of salinity on, 14334
re concentration of salt, 15510
re stocking density and water turnover in tanks, 14363
re temperature and dietary lipids, 14892
changes, re coastal movements of Atlantic menhaden, 14451
cod, Atlantic, plus metabolism and oxygen consumption, 15290
condition of fish from thermally-affected reservoir, 15092
crappie, black, in Lewis & Clark Lake, So. Dakota, 14579
croaker in brackish-water ponds, 14325
dace, rosyside, 14894
development of coral-red rockfish off Southern California, 15495
eel, European, freshwater-, determination of age and growth of, 15456
feeding frequency for a maximum daily ration, re 6 fishes, 14836
fish, influence of water temperature on, 14540
grayling in Ourthe River, 14902
growth,
model and estimation of optimum age of fish populations, 14510
of 4 species of bass in ponds, 15501
hybrid sunfish populations, supplemental feeding of, 14439
ide, size and age at maturity, ripening and fecundity of, 15158
menhaden, young, in White Oak River estuary, No. Carolina, 14651
minnow,
fathead, re long-term exposure to carbaryl, 15263
silverjaw, in Kentucky, 14484
muskellunge, known-age, growth in Wisconsin, plus methods, 14397
parr-smolt transformation in salmonids, gill ATP activity changes re, 15080
perch,
European, rate at which it populates lakes, 14917
pile, in Yaquina Bay, Oregon, 14933
white, in Delaware River, near artificial island, 14544
yellow,
in Little Missouri Arm of Lake Sakakawea, No. Dakota, 15284
length and weight growth of, in bay of Lake St.-Louis, 15255

Age and growth, cont.
pike, northern,
in two Scottish lochs, 14576
of Lake Pleshcheyevo, 14383
plaice larvae, effects of food density, 15288
re temperature requirements of salmonids, 15214
redhorse,
river, from Cahaba River, Alaska, 14326
silver, in Flint River, Alabama, 14683
salmon,
chinook,
fall-, from Columbia River hatcheries, re yield, 14991
fingerlings, as affected by egg size, 15088
in Rangitata River, New Zealand, 15286
juvenile-, spring-, in Lookingglass Creek, 14231
premigratory-, in sea water, 14650
chum,
early marine growth and fatty acid changes during migration, 15272
marine growth, 14634
pink, via marking, 14387
quinnat, in New Zealand, 14249
sockeye,
juvenile, effect of fertilization of Great Central Lake, 14647
responses of young to different diets, 14611
Salvelinus alpinus on Sakhalin Island, 15228
sauger, in Lake Sakakawea, No. Dakota, 15440
scale patterns and growth of laboratory-reared Pacific sardine, 15498
shad, American, in St. John's River, Florida, 14947
soles, age determination methods in, 15009
stickleback, ninespine, early growth of, 15189
sturgeons, maximum size and age, USSR, 14923
sucker, white, effect of water quality change on, 14336
sunfish populations in thermally-influenced lake, 14345
tilapia, growth in sea-water ponds, 15019
trout,
brook,
effect of lime-neutralized iron hydroxide suspensions on, 15481
effects of Floy anchor tag on, 15220
young-, temperature re growth and survival, 15612
brown,
biology re commercial size in Karelian lakes, 14912
in Irish waters, 15043
in Finnish lakes treated with rotenone, 14897
in Llyn Alaw, Wales, 15289
lake, DDT residues as function of age, 15132
rainbow,
exposed to X-rays in eyed embryo stage, 14295
growth rate, from autumn and spring spawning, 15248
juvenile, in a Lake Michigan tributary, 14726
Von Bertalanffy growth curve, application to capture-recapture data, 15291
walleye, in Lake Sakakawea, No. Dakota, 15440
whitefish, round, thru otoliths, 15218

Anatomy,
alimentary tract of northern pike, 14263
anomalies of fishes, bibliography, supplemental listing, 14670
brain acetylcholinesterase from cutthroat trout, 14447
caeca, pyloric
alkaline RNA-hydrolyzing enzyme in, rainbow trout, 14854
of mackerel, properties of proteinase from, 14833

Anatomy, cont.
color,
mutant of chain pickerel, 15196
pattern development in young of 5 species of bass, 15500
curvatures, abnormal-, body-, of inbred rainbow trout fry, 14981
darters, johnny and tessellated, and hybrids, comparison of, 15620
description of young menhaden in White Oak River estuary, N. C., 14651
developmental abnormalities of lined sole, 14268
digestive system, teleost-, development in postlarvae, 15268
dimorphism, sexual,
of tilapias in Israel, 14328
re chromatin patterns in fishes, 14625
ecostructural studies on olfactory organ of sea trout, 15476
epiphysis cerebri of fish, slow potential from, 14844
eye-lines of fish, attitude of, re body shape and stripes and bars, 14747
gill,
ATP activities as indicator of temperature effects in steelhead migration, 15050
eel-, localization of 4-^{14}C cortisol in, 15298
epithelium of eel, temperature dependence of permeability to water and sodium of, 15354
mechanisms of salt transfer in fresh and sea water, 14509
new preparation for study of ionic regulation in teleosts, 15413
phospholipids of, 15251
rainbow trout-, toxic effects of zinc sulfate on, 15296
ultrastructure of Monodactylus argenteus, changes with varying salinity, 14798
gills,
chloride transport by, in rainbow trout, 14779
infra-red photo technique for studying vessels of, 15039
gonads, carp-, preparation of monolayer tissue culture from, 15403
hermaphroditic alewife from Rappahannock River, 15628
intestine,
bluefish-, aerobic microflora of, 15150
carp-, absorption of nutrients in, and pH of chyme, 14386
thiaminase activity in some freshwater fishes, 14524
kidney, phagocytosis of bacteria by cells of, in carp, 15004
lateral line,
sense organs, fine structure of, in dogfish, 14879
system of fishes, nervous connections between neuromasts, 14616
length and weight,
of yellow perch, effects of formalin on, 15193
relationships in red porgy caught off S. C., 15585
liver,
arginase activity in sockeye salmon, 14569
-cell-free system, synthesis of protamine in, in rainbow trout, 15449
degradation of adenosine 5'-monophosphate in, rainbow trout, 14847
eel-, effects of pentachlorophenol on energy-metabolism enzymes in, 15059
morphology and enzyme histochemistry of, in bass, 15257
post-mortem degradation of nucleotides in, rainbow trout, 14842
thiaminase activity in some freshwater fishes, 14524
lymph system of plaice and other teleosts, 14475
metamorphosis of sea lamprey, timing of changes in blood, morphology, and behavior, 15537
midgut of Salmonidae, comparative histological study of, 14919
morphological,
description of Lake Sevan whitefishes, 15223
features of silver carp and bighead, and hybrids, 14738

Anatomy, cont.
morphology of,
adrenal cortical cells, changes during freshwater spawning journey of salmon, 15149
bream inhabitating warm water from power station, 14922
cottid genus Myoxocephalus, 14571
muscle,
-catheptic activity of some marine species, 15036
field technique for sampling from living fish, 14298
skeletal,
alanine aminotransferase in, carp, 14999
isozymes of aspartate aminotransferase in, 15012
marine fishes, degradation of inosine 5'-monophosphate in, 14290
walleye, genetics of MDH isozymes in, 14238
white-, cardiac- and red-, proteinic criteria of differentiation of, in carp, 14998
olfactory apparatus, development in cutthroat trout, 15179
optic system of some marine fishes, study of, 15484
osteological characters re taxonomy of Salvelinus, 15222
osteology of bluegill, 15066
otoliths,
for aging round whitefish, 15218
use in herring stock identification in Canadian waters, 15613
ovaries,
fish-, quantitative assessment to characterize state of, 14393
teleosts-, hormonal control of, 15435
pathological-, role in ichthyotoxicology, 14431
pituitary,
goldfish-, histophysiology and innervation via microscopes, 15358
of freshwater fish, histology of ACTH cells in, 14848
polyodontids, 14382
reversed butter sole, first record, 15467
scale,
characters for identification of pink salmon runs, 15147
features of sockeye from Asian and North American coasts, 14652
of young sockeye of Lake Azabach'ye, structural features, 14388
patterns for identifying races of spring chinook in Columbia River, 14229
size at first annulus as permanent mark of bass, 14332
scales,
fine structural aspect of, in chum salmon fry, 14830
of young sockeye, starvation, feeding and light re circulus formation, 14760
silvery layers of fish, reflection mechanism in, 14513
skeleton, pelvic, variation in occurrence in stickleback, 15371
skin,
composition of amino acids in mucus of, 15409
mucus of Black Sea fishes, chemical composition of, 14521
seasonal change of purine content of, in masu from parr to smolt, 14846
soft rays in teleosts, re-examination of functional morphology, 14554
stomach of brook trout, thermal compensation in, 14565
swimbladder,
bluegill, effects of temperature on gas secretion, 14558
disease of the carp, epizootology, diagnosis and prophylaxis, 15000
inflammation of, in carp, characteristics of, 15439
morphology and specific gravity of myctophids off Ore., 15617
variation in length and volume in four daces, 15074
tailless Dover sole from Oregon coast, 14942
tapeta lucida in eyes of seatrout, 15062
testis,
salmon, immature-, ribonucleotide reductase in, 14608

Anatomy, cont.
testis, cont.
trout,
new histone from, 14466
phosphorylation sites in protamine biosynthesis, 14778
rainbow, specificity of 11β-hydroxylase in, 15071
transformation of chromatin of, 14467
vertebral,
column, crooked-, in juvenile Atlantic menhaden, 14547
count re egg size in medaka, 14493
xanthochroic gar from Mississippi, 15192
yolk sac syncytium of muskellunge, giant nuclei formation in, 14465

Bacteriology,
Aeromonas,
infection in Loch Leven brown trout, 15308
liquefaciens,
agent of hemorrhagic septicemia of carp, furazolidone for control of, 14617
antibody detection in fish via fluorescent antibody technique, 15087
detection with immunofluorescent techniques, 15517
from freshwater fishes, re drug sensitivity, 14837
isolation from bass eggs, fry, 14372
punctata, antigen production in carp for immunization, 14315
salmonicida,
from sablefish and salmon, 14610
virulence and persistence of forms inoculated into coho, 15085
bacteria,
associated with surface of stream-incubating Pacific salmon eggs, 14601
fish-pathogenic-, effect of 2 iodophors on, 15545
growing on peled spawn, 14776
intestinal-, of carp, folic acid production by, 15011
of digestive organs of Black Sea fishes, re synthesis of cobalamins, 14527
phagocytosis of, by carp kidney cells, 15004
phenol- and thiocyanate-decomposing-, re natural purification of Dnieper reservoirs, 14925
bacterial,
counts of commercial fish diets, 14297
fish pathogens, in vitro studies of nifurpirinol (P-7138) against, 14705
gill disease, studies on, in hatchery salmonids, 14949
population,
in salmonid incubation trays, 15260
of diets for aquarium fishes, 15216
bacteriological study of death of fish during transportation, 14835
Chondrococcus columnaris,
antibody- and immune response of salmonids to, 14495
disease, seasonal distribution from specific agglutinins, 15081
susceptibility of juvenile salmonids to, 14758
Clostridium botulinum, tank trout as carriers of, detection, 14624
Leucothrix mucor infestation of benthic crustacea, fish eggs and algae, 14793
microflora, aerobic, of bluefish intestine, 15150
myxobacteria, selected-, pathogenic for fish, studies on, 14949
nitrogen-fixing bacteria,
distribution in,
fresh waters, 14855
sea waters, 14856
in culture ponds, 14858
Vibrio anguillarum,
cause of "red mouth" enzootic in hatchery rainbow trout, 15306
re vibrio disease in wild Norwegian fish, 14644

Behavior,
activity,
of Hawaiian reef fishes at dawn and dusk, 15490
response of brook trout to chlorine, 14996
adjustment of juvenile Atlantic salmon population density to available food, 14478
aggregation, induced-, of pond-reared rainbow trout thru acoustic conditioning, 14728
agonistic- and territorial-, first stages of, re brown trout in artificial brook, 14903
bass, largemouth, winter responses to thermal effluent, 15095
bluegill-, effects of negative buoyancy on, 15588
breeding habits of 2 subspecies of longnose dace, 14804
conditioned reflex activity of guppies, effect of phenol on, 14515
conquest of territory by brown trout re initial population density in artificial brook, 14901
eel, in magnetic fields, mechanism of reception, 15231
feeding,
and interaction of cutthroat trout and Dolly Varden, 15259
chronology and food habits of catfish in Conowingo Reservoir, 14663
of juvenile sockeye, re fertilization of Great Central Lake, 14647
of whitefish and herring in Torch Lake, Mich., 15577
fish,
activity studies using ultrasonic sensors, 14322
in Lake Monona, Wis., re thermal effluent, 15607
influence of water temperature on, 14540
flicker-Erg in rainbow trout, funa and eel, 14857
flight distance in zebra danio, determined by visual mechanism, 14899
Gambusia hybrid swarm, competition and isolation mechanisms, 14426
habitat selection and spatial interaction by juvenile steelhead and chinook, 15038
homing,
of transplanted coho salmon, 14366
olfaction in parent stream selection by alewife, 14542
intraspecific intrusions into nests of spawning longear sunfish, 15200
locomotor,
effects of sublethal DDT on, in goldfish, 15541
patterns of pumpkinseed re level of illumination, 15293
responses of male channel catfish to pheromone of female, 15182
small sonic tag for measuring, 14784
mate selection in pumpkinseed and longear sunfish, 14802
nest-digging-, of rainbow trout, 14631
net avoidance in shad as observed by ultrasonic tracking, 14293
of reservoir fishes, evaluation of transmitter for studies of, 15528
orientation of,
goldfish in response to copper gradient, 15030
young fishes in a photobarogradient chamber, 14874
periodicity, daily-, of blinded brook trout, 15312
photic, of walleye, effects of D.O. depletion and CO_2 buildup, 14500
plaice larvae, effects of food density, 15288
re temperature requirements of salmonids, 15214
respiration, aerial, of young gars, social aspects, 14791
response,
conditioned, effects of 4 insecticides on learning and retention by salmon parr, 15151
of bluegill to seismic shock, 15115
of teleost to restricted environment, 14409
salinity selection by mosquitofish, effect of DDT and malathion on, 15188
salmon,
Atlantic, hatchery and wild, effects of crowding on, 14895
sockeye, individual and in group, 14944

Behavior, cont.
schooling,
estimating distances between fish and aquarium, 14763
of some Baikal fishes, daily changes in, 15232
of tuna, sensory factors in positioning, 14654
spacing and density in stickleback and mummichog, 14236
segregation between cutthroat and Dolly Varden populations, 14496
sharks, reactions to gill-net barriers, 15294
social-, role in dispersal of introduced rainbow trout, 14240
sounds, spawning-, of red salmon, 14399
spawning,
pink salmon on artificial redd, 15178
red shiner in Burro Creek, Arizona, 15072
redbreast sunfish in southeastern N. C., 15524
silver redhorse in Flint River, Alabama, 14683
swimming,
ability of fed and starved larval bass, 14786
and feeding,
of larval anchovy, 15492
re oxygen consumption of aholehole, 15035
compensatory, by sockeye in response to negative buoyancy, 15204
speed of juvenile coho, effects of temperature on, 15144
temperature selection of trout fingerlings vertically and horizontally, 14765
territoriality and courtship in Olympic mudminnow, 15473
trout in small streams of northern Idaho, 14145
tuna, skipjack, spontaneous activity re temperature changes, 15422

Benthos,
Chironomidae of So. Dakota, 14655
Chironomus tentans, uptake and distribution of DDE by, 15185
community,
metabolism in Bay of Quinte and Lake Ontario, 14755
structure from diversity indices, Keystone Reservoir, Okla., 15236
crayfish,
as indicator of mercury pollution, 15436
exploitation by bass in Ohio pond, 14714
effects of,
electrofishing on, in English stream, 14907
zectran on, in Idaho creek, 15186
food and feeding studies, USSR, 15215
Gammarus pseudolimnaeus, toxicity of chloramine to, 14972
insects, aquatic,
drift and production in mountain stream, 15474
effects of dursban on, 15472
effects of high water temperature on adult emergence, 14378
of Pine Popple River, Wis., 14962
invertebrates, pond-, effects of malathion on, 15610
macro-, in ponds, effects of inorganic fertilizers and organic matter on, 14346
macroinvertebrates,
associations and species, Bay of Quinte and Lake Ontario, 14753
comparison of 3 methods of handpicking, 15530
in cold tailwaters and streams, Ark., 14331
production, Bay of Quinte and Lake Ontario, 14754
meio-, quantitative count of, 14927
mercury accumulation in food chains, 14861
microbial communities of fresh water, structure and function of, 14491
Naididae in Lake Baikal, new data on, 15023
of Canandaigua Lake, New York, 15368
Oligochaeta,
consumption by fishes and invertebrates, 14390
distribution in Estonian lakes, 15443
of Chud-Pskov Lake, 15477

Benthos, cont.
Pontoporeia affinis, culture, reproduction and temperature tolerance of, in laboratory, 15173
re trout in Finnish lakes treated with rotenone, 14897
reduction below dam, chain in thermal regime as cause, 15540
samples,
basket for washing of, 14403
sugar flotation and dye for sorting of, 14441
shrimp,
movements over weirs in La. marshes, 15535
tagging using internal anchor tags, 15177
toxicity of crude oils and dispersants to, 15534
snails, correlation of structure vs. activity of freshwater pollutants, 14905
stream-, recovery from acid mine drainage effects, 15295
trapped leaving bottom of Bideford River, P.E.I., 15626
tubificids, possibility of propagation of, 15478
zoo-, improved sampling techniques re new model of Kajak sampler, 14822

Bibliography,
anomalies of fishes, supplemental listing, 14670
blue crab, fishing industry and biology of, 14284
crappie, white-, and black-, life history references, 15053
detergents in water, 15021
electrofishery and its principles, 14479
gas-bubble disease of salmonids, critical review, 14950
hematology, fish-, bibliography, 15202
inland fisheries and aquaculture, 15277
Lake Ontario,
biology studies, 15032
chemistry studies, 15031
physical studies, 15033
limnologists, fishery-, world list of, 14628
mercury in water, 15022
parasites of cyclostomes and teleosts of Poland, 15139
PCB in water, 15020
polyodontids, systematics - anatomy - ecology - biology - fishery, 14382
radioecology, terrestrial and freshwater, 15025
TFM as a lamprey larvicide, review of literature on, 14961
zooplankton, marine-, of Canada, synopsis, 14311

Biocides,
herbicides,
alisep, fish toxicity, 14401
avadex, fish toxicity, 14401
butyl ester of 2,4-D, tolerance of young striped bass to, 14669
celatox, fish toxicity, 14401
clearance and registration for aquatic use, 14225
copper sulfate, tolerance of young striped bass to, 14669
2,4-D,
ester, dynamics in organs of 3 fishes, 15064
fish toxicity, 14692
toxicological effects on fish et al., 14583
dichlobenil, uptake and effects in small pond, 14578
endothal, toxicological effects on fish et al., 14583
evaluation of algicides, 14623
karbine, fish toxicity, 14401
karmex, tolerance of young striped bass to, 14669
picloram, fish toxicity, 14692
propazine, fish toxicity, 14401
pyramin, fish toxicity, 14401
urea derivatives, chronic effects on fish and their food, 14932

Biocides, cont.
insecticides,
abate, re ability of salmon parr to learn and retain conditioned response, 15151
aldrin,
acute toxicity to surf perches, 14945
epoxidation in fishes re MFO enzymes, 14898
carbaryl, long-term exposure re survival, growth and reproduction of minnow, 15263
^{14}C-DDT, retention in cellular fractions of resistant and susceptible fish, 15401
cyclodiene-, photoisomers of, toxicity-metabolism relationship of, in freshwater animals, 15363
DDE, uptake and distribution by chironomid, 15185
DDT,
accumulation,
and persistence in lotic ecosystem, 14976
from water by golden shiners, 15511
acute toxicity to surf perches, 14945
alters species composition in mixed cultures of algae, 14967
and related compounds, inhibition of ATPase activity in fish homogenates, 14552
degradation by goldfish, 14550
effect on,
fertility of northern pike of Netherlands, 15106
salinity selection by mosquitofish, 15188
vulnerability of salmon parr to trout predation, 15029
effects of dressing and cooking on amount in fishes, 15256
in,
8 California marine fishes, 14815
Great Lakes fish, 14796
young salmon after forest spraying, 14511
inhibits Na^+, K^+, Mg^{2+}-ATPase in marine teleosts, 14508
intoxication in rainbow trout as affected by dieldrin, 15400
re ability of salmon parr to learn and retain conditioned response, 15151
residues,
from 2 Mississippi oxbow lakes, 14330
in lake trout as function of age, 15132
in white croakers, 15462
separated from PCB's on silica gel, 14584
sublethal-, effects on locomotor behavior of goldfish, 15541
uptake re respiration in mosquitofish, 14476
dieldrin,
acute toxicity to surf perches, 14945
dietary-, phenylalanine metabolism altered by, 15450
effect on DDT intoxication in rainbow trout, 15400
in Great Lakes fish, 14796
levels in fish from Iowa streams, 15212
dursban,
effects on pond plankton and insect populations, 15472
toxicity to pond fish and invertebrates, 15575
dylox, tolerance of young striped bass to, 14669
endrin,
acute toxicity to surf perches, 14945
residues from 2 Mississippi oxbow lakes, 14330
ethyl parathion, tolerance of young striped bass to, 14669
hexachlorocyclohexane-induced malformations during fish embryogeny, 14434
malathion,
effect on salinity selection by mosquitofish, 15188
effects,
in estuaries of Gulf- and SE Atlantic coasts, 15455
on pond fishes and invertebrates, 15610

Biocides, cont.
insecticides, cont.
methoxychlor,
acute toxicity and breakdown studies, 15181
re ability of salmon parr to learn and retain conditioned response, 15151
methyl parathion, tolerance of young striped bass to, 14669
parathion, activation in fishes re MFO enzymes, 14898
phozalon, prediction of residue dynamics in waters, 15136
possible mechanism of resistance in mosquitofish, 14533
sumithion,
effect on vulnerability of salmon parr to trout predation, 15029
re ability of salmon parr to learn and retain conditioned response, 15151
thanite, effects on carp blood chemistry, 15091
zectran, effect on trout and benthos in Idaho creek, 15186
molluscicides, correlation of structure vs. activity of freshwater pollutants, 14905
pesticides,
akton, vertebral damage in bluegills from toxic dose, 15184
chlorinated-, chromatography-mass spectrometry of residues, 14622
column extraction from fish, fish food, mud, 15110
demeton, vertebral damage in bluegills from toxic dose, 15184
2, 4-dinitrophenol, effect on respiration in herring embryos, plus metabolite concentrations, 14795
dry ice homogenization for fish samples in residue analysis, 14718
dyrene, vertebral damage in bluegills from toxic dose, 15184
effects on,
estuaries of Gulf- and Southeast Atlantic coast, 15455
growth and ^{14}C assimilation in alga, 15299
non-target species, 14717
O_2 use of estuarine fish, via respirometer, 15527
expanded program for monitoring in fish, 15213
high in 4, 6-dinitro-O-cresol, toxicity for fish, 14281
HTH, tolerance of young striped bass to, 14669
in estuaries, 14586
methyl parathion, vertebral damage in bluegills from toxic dose, 15184
organochlorine, inhibition of ATPase in rainbow trout, 14567
organophosphate, level of brain AChE inhibition re death in sheepshead minnows, 15592
pentachlorophenol, effects on energy-metabolism enzymes in eel liver, 15059
persistent, environmental contamination by, 15444
phosalone, vertebral damage in bluegills from toxic dose, 15184
residues of 20 Mississippi delta lakes, 14675
trichlorfon, vertebral damage in bluegills from toxic dose, 15184
piscicides,
anhydrous ammonia, use in fisheries management, 14347
antimycin,
exposure times required to kill carp, sucker, bullhead, 15079
half-life of biological activity via fish bioassay, 14734
sensitivity of white amur to, 14707
antimycin-A, improved method of treating ponds for sunfish control, 14673
bayluscide, sensitivity of white amur to, 14707
huratoxin, isolation and characterization, 14637
juglone, sensitivity of white amur to, 14707
rotenone,
benthic fauna re trout in treated Finnish lakes, 14897
exposure times required to kill carp, sucker, bullhead, 15079
oxidative metabolism re selective toxicity, 14279
sensitivity of white amur to, 14707
tolerances of some fishes of Natal, 14364

Biocides, cont.
piscicides, cont.
salicylanilide I,
an effective, non-persistent, candidate, 15591
sensitivity of white amur to, 14707
squoxin, tolerance of juvenile sockeye and zooplankton to, 15551
TFM as lamprey larvicide, review of literature on, 14961
poisons, phenol intoxication of fish, effect of anticholinesterases on, 15121

Chemical factors,
Biloxi Marsh Complex, La., re sport fishes in, 15027
cadmium,
acute and chronic toxicity to fathead minnow, 15611
content of fish from 49 waters of New York, 15538
calcium, effect on development and hatching of coho embryo, 15573
chemical analyses of drinking water supplies including trace metals, Wis., 15126
chemistry studies of Lake Ontario, bibliography, 15031
classification of waters, 14380
CO_2 changes, reactions of salmon to, re locomotor restraint and anesthesia, 15160
copper, effect on blood serum osmolality of catfish, shiner, 14442
dependence of primary production on, in small eutrophic lake, 15133
elements, model of cycling in estuaries, 15496
hardness,
of natural waters, 14379
water-,
effects on fish production in plastic pools, 14342
re survival of striped bass fry stocked in earthen ponds, 15522
hydrogen sulfide, effects on fish eggs and fry, 15314
hypersalinity tolerance of Calif. killifish, field measurements of, 15633
in developing reservoir in Texas, 15457
influencing local distribution of sheepshead minnow, 14732
Keystone Reservoir, Okla., and species of net zooplankton, 14752
mercuric ion, rapid uptake by goldfish, 14577
mercury,
accumulation in food chains, 14861
content in Myoxocephalus in Finland, 14818
levels in an oligotrophic- and eutrophic lake, 14256
occurrence and effects in ecosystem, 14900
metals, heavy, in Great Lakes, 1970-71, 14377
nitrogen,
dissolved-, fish tolerance to, 14253
supersaturation re thermal tolerance of juvenile salmonids, 14408
nitrogen-fixing,
bacteria,
distribution in,
fresh waters, 14855
sea waters, 14856
in culture ponds, 14858
potential of plankton in 2 farm ponds, 15238
nutrient parameters in water via algal assay method, 15083
oxygen,
adverse regime re blood composition of stickleback, 14915
concentration in fish tank, monitored with digital recorder, 14296
depletion in eutrophic reservoir, continuous system models of, 14751
dissolved-,
effects on survival of striped bass eggs, larvae, 14420
low-, chronic effects on fathead minnow, 14289
minimum required for normal fish life, 14838
requirements of larvae of blenny, goby, skilletfish, 14890
three methods for determining concentrations near fish embryos, 14710

Chemical factors, cont.
oxygen, cont.
diurnal, use of curve for estimation of primary productivity in trout stream, 15240
re effect of cadmium on mummichog, 15168
pH,
changes, reactions of salmon to, re locomotor restraint and anesthesia, 15160
dependence of affinity, kinetics and cooperativity of ligand binding to carp hemoglobin, 15008
differences of micro-habitat from those of surrounding water, 14410
effect on toxicity of zinc to bluegill, 14906
lethal-, for white sucker, 15191
low-,
and high content of Fe compounds, destructive effects on fish, 14587
anoxia and Na loss in death of brood trout at, 14810
re effect of cadmium on mummichog, 15168
values, extreme-, and inland fisheries, 14282
phosphorus dynamics in ponds, 15508
piscicides, rotenone, tolerance in mosquitofish, 15127
salinity,
and handling re oxygen requirements of striped bass, 14970
effect of stress on eggs and larvae of Salton Sea fishes, 14814
effects on,
antioxidation systems in non-anadromous fish, 15486
channel catfish growth and survival, 14334
early development of Pacific herring, 14602
ion regulation in alewife, 14440
survival of striped bass eggs, larvae, 14420
indicator for use in marine fish farming, 15122
re effect of cadmium on mummichog, 15168
re oxygen consumption of aholehole, 15035
selection by mosquitofish, effect of insecticides on, 15188
temperature re plasma osmolality and ion level in Atlantic salmon, 15624
tolerance of,
catfish hybrids, 14445
young blueback herring, 14739
salt,
effect of concentration on channel catfish growth, 15510
tolerance of embryonic Miss. silverside, 14438
sea water, tolerance of grass carp to, 14746
trace elements and algal "bloom", 14534
water quality,
effect of alteration on white sucker growth, 14336
in Montrose Reservoir, effects of acid mine drainage on, 15373
of Lake Jacomo, Mo., 15105.
zinc,
confirmation of autopsy technique for fish mortality from, 14462
effect on,
blood serum osmolality of catfish, shiner, 14442
viral-host interactions in RTG-2 cell line, 14376
localization in carp spawn, embryos and larvae, 14775
use of fish movement patterns to monitor in water, 15244
^{65}Zn and stable Zn, distribution in experimental marine ecosystem, 14764

Chemicals,
acid stress in fish, histochemical and cytophotometric assay of, 14908
alizarin red S, for vital staining of carp hard tissues, 15002
aluminum hydroxide complexes, toxicity to rainbow trout, re pH, 14443
ammonia, anhydrous-, use in fisheries management, 14347
Aroclor 1221, major components of, 15265
α-TNT, acute toxicity to bluegills, 15460

Chemicals, cont.
calcein, for vital staining of carp hard tissues, 15002
chloramine, toxicity to fathead minnow and amphipod, 14972
chlorine,
activity response of brook trout to, 14996
residuals, toxicity to freshwater fish, 14875
copper gradient in water, orientation of goldfish in response to, 15030
detergents in water, bibliography, 15021
dimethyl ammonium alkyl hydroxamate, chemistry and toxicity to brook trout, 15111
fatty alcohols, for covering water, influence on temperature in carp ponds, 15007
flocculants, synthetic-, polymeric-, for flocculation of algae in pure culture, 15015
formalin, effects on length and weight of yellow perch, 15193
magnesium silicide for sample decomposition in determination of N, S and halogens in organic substances, 14432
mercuric chloride re tissue culture bioassay method for water pollution, 15254
mercury in water, bibliography, 15022
methylmercury in freshwater and marine fishes of eastern Canada, 14498
NTA, effect on growth and metabolism of estuarine phytoplankton, 15166
organometallic compounds, chemical composition re toxicity for hydrobionts, 15153
PCB's,
alter species composition in mixed algal cultures, 14967
biological magnification from water by invertebrates, 15129
chromatography-spectrometry characterization of, plus ^{36}Cl-labelling, 14887
in estuaries, 14586
in water, bibliography, 15020
long-term exposure re ATPase activity in minnow, 15108
phenol,
effect of low concentrations on antibody formation in carp, 14428
intoxication of fish, effect of anticholinesterases on, 15121
phenylmercuric acetate,
effect on hatching frequency of zebrafish eggs, 15109
toxicity to phytoplankton, 15138
phosphorus halides, effect on fish ontogeny, 15125
potassium dichromate and chromanganate, 14669
proteolytic washing enzymes, effects on fish and other organisms, 14954
surfactants, synthetic, effect on olfactory function of Atlantic salmon, 14896
tetracycline-HCl, for vital staining of carp hard tissues, 15002
toxicological assays with fish, 14592

Competition,
and isolation mechanisms in Gambusia hybrid swarm, 14426
croaker and spot in 2 Gulf of Mexico nursery areas, 15404
food resource division among northern marine demersal fishes, 15423
trout, cutthroat, and Dolly Varden, feeding behavior and interaction of, 15259

Culture,
acoustic conditioning for induced aggregation of pond-reared rainbow trout, 14728
aeration to prevent winterkill, evaluation of 2 methods, 15564
anchovy and sardine larvae in laboratory, food level re growth and survival, 15318
aquaculture,
and inland fisheries, bibliography, 15277
high-density-, rotable cage for, 14701
attributes of silver carp and bighead, 14738
bass,
largemouth, spawning under laboratory conditions, 15589

Culture, cont.
bass, cont.
striped,
fingerling production at Okla. hatcheries, 14351
food habits of fingerlings in culture ponds, 15520
in Oklahoma, 15518
survival of fry stocked in earthen ponds re age, source and water hardness, 15522
blood sample preservation for hemoglobin assay, 14711
bluegill, development and growth thru one year, 15067
bottle, Mariotte, lightweight-, for field, laboratory and hatchery, 14371
cage-,
for commercial use in large reservoir lakes, 15274
of channel catfish in reservoir lakes, 14676
of trout, 15273
carp,
epizootology, diagnosis and prophylaxis of swimbladder disease, 15000
etiology and epizootology of gill disease, 15001
fingerling-, nutrition and growth in hatchery ponds, USSR, 14532
from adhesive and degummed eggs, comparative evaluation of, 14921
grass-,
and silver-, propagation thru pituitary injection, 14865
spawning and rearing, 14682
in recirculating water, preliminary experiments, 15005
use of,
malachite green against Gyrodactylus in, 15437
phenasal against bothriocephalesis in carp, 15438
catfish,
channel,
aquatic plants as ingredients in feeds for, 14688
dietary lipids and temperature re metabolism, growth and composition, 14892
digestibility of nutrients in semi-purified rations, 15509
effects of lipids on growth, conversion, lipid and fatty acid composition of catfish, 15116
feeding rates and temperature re growth, conversion and body composition, 14733
high-density-, stocking and water requirements for, 14893
in cages suspended in ponds, 14323
photoperiod re growth and food conversion, 14362
stocking density and water turnover re growth and conversion in tanks, 14363
under intensive conditions, 15097
in brackish water ponds, 14354
circulating seawater system for studies with crabs, 14716
cleaner, hatchery-trough-, 14365
combined-, of carp and grass carps in Ukraine, 14743
control of unicellular parasites with formalin, 15570
copepods, planktonic-,
advances in continuous culture of, 15167
continuous recirculating system for, 15170
Coregonus peled, development of 0+ fry in ponds, 15292
crustacean-, alginates as binders for rations, 14702
Dicentrarchus labrax, first positive results of broad-scale artificial propagation, 15305
diet and growth of grass carp in Russian fish-farm ponds, 14737
exercise and handling re body weight of fish, 15084
FAO Aquaculture Bulletin, 14273, 14305, 15164, 15271, 15420
fatty alcohols for covering water, influence on temperature in carp ponds, 15007
feeding frequency for a maximum daily ration re 6 fishes, 14836

Culture, cont.
fertilization of,
pink salmon eggs by sperm from gonadotropin-injected juveniles, 15028
steelhead trout eggs with cryo-preserved sperm, 14979
fish-,
in,
domestic waste water in Poland, 14307
heated effluents, Poland, 14309
Israel in 1970, 14594
sugar beet waste ponds, Poland, 14308
selected terms in, FAO Bulletin, 14955
superintensive-, in Beith-Shean Valley, Israel, 1969-70, 14598
fishes, freshwater-, of Ecuador, prospects for propagation, 14318
formalin,
pathological effects in treated trout, 15125
treatment stress in salmonids, 14978
grader, catfish-, development and operating efficiency of, 15090
grayling, Baikal, black, blood characteristics re rearing conditons, 15482
grunion, influence of temperature on rearing of, 15045
herbivorous fish,
experience in Czechoslovakia, 14736
in USSR, 14742
herring, Pacific, in the laboratory, 14699
ichthyophthiriasis, review of control methods, 15563
incubation of eggs of autumn-spawning rainbow trout, 15247
incubator,
fish-egg-, inexpensive design, 15566
pelagic-egg-, for use on ships, 14920
infestation of fish eggs by Leucothrix mucor, 14793
interaction between common carp and silver carp, 14596
jar incubation of channel catfish eggs, 14697
lime for fertilization of fish-breeding ponds, 14926
malachite green-formalin mixtures for control of ich and other protozoans, 14706
mariculture, a brief on, 14969
marine-, fish-, salinity indicator for use in, 15122
monolayer-, cell-, of bream kidney tissue, 15093
mullet growth in ponds with tilapia and carp, 15608
nursery pond as tool in fishery management, 14349
nutrition of fishes under intensive production, 14316
oxygen, dissolved, 3 methods for determining levels near fish embryos, 14710
pellet dispenser, automatic, for experimental feeding of fishes, 15558
phytophagous fishes,
in USSR, results, 14417
role of infusoria in food of larvae, 14871
pikeperch spawn incubated in nests out of water, 14519
poly-, of catfishes in brackish ponds, 15512
pond-, -chemicals, tolerance of young striped bass to, 14669
ponds, nitrogen-fixing bacteria in, 14858
Pontoporeia affinis, in laboratory, 15173
propagation of Caspian sturgeon stocks based on their biology, 14914
pupfish, Red River, development rates and temperature tolerances of, 15112
question of, for salmon of Pechora River, USSR, 15454
recirculation unit, compact, for rearing and maintenance of fish, 15430
sablefish, preliminary study of, 15086
salmon,
Atlantic,
hatchery- and wild-, effects of crowding on, 14895
immature, hematological parameters of, 15559
incubation temperature re larvae condition, 14396
chinook, mortality of fingerlings re egg size, 15088

Culture, cont.
salmon, cont.
coho, effect of,
calcium on development and hatching of embryo, 15573
starvation time on amount of food eaten, 15561
salmonid,
-hatchery wastes, evaluation of, 14720
incubation trays, bacterial population in, 15260
sanitation methods for salmonid facilities, 15453
separating and incubating winter flounder eggs, 15102
sexing bluegills, method for, 14704
sorting device for salmonid eggs, 14370
spawning, induced, of gilthead, Italy, 14888
sperm storage and dilution, effects on fertilization of brook trout eggs, 15565
sterilization of water with UV rays, 15131
study tour of No. American fisheries by New Zealand group, 14285
sunfish hybrids, supplemental feeding of, 14439
tank trout as carriers of Clostridium botulinum, detection of, 14624
tannin solution used in walleye and carp culture, 14700
temperature control system for recirculation fish-holding facilities, 15432
Tilapia aurea growth in sea water ponds, 15019
treatment,
of hatchery water supplies for control of Ceratomyxa shasta, 14703
with masoten for external parasites; determination of metrifonat residue, 14889
trout,
ponds in western Ukraine, hydrobiological description, 14530
rainbow,
effect of starvation and rate of artificial feeding on fry in winter, 15249
essential fatty acids,
in diet,
deficiency symptoms, 15117
growth, feed conversion and deficiency symptoms, 15120
lipid metabolism and fatty acid composition of, 15118
growth rate from autumn and spring spawning, 15248
hatchery-, survival re stamina tunnel ratings, 15424
influence of parasitic copepod on, 15187
protein efficiency re amount in feed, 15073
significance of egg carotenoids and vitamin A in early embryogenesis, 15114
therapy for eggs infected with Saprolegnia, 15557
tubificids, possibility of propagation of, 15478
viability of embryos re respiration of spawn from roach and bream of different ages, 14520
virucidal activity of 2 iodophors to salmonid viruses, 15034
vitamin fortification, effect in Auburn No. 2 fish feed, 14638
walleye,
observations on incubating eggs, 14713
using artificial food, 15096
water requirements of salmonids, formulae for calculation of, 14369

Diet,
Abernathy-, salmon-, tests of variations of, 15302
alginates as binders for crustacean rations, 14702
aquarium-fish-, bacterial population of, 15216
artificial food,
for hatchery rearing of walleyes, 15096
re fecundity of largemouth bass, 14681
calorie-to-protein ratio for brook trout, 14288
carp, grass, in Russian fish-farm ponds, 14737
catfish, channel, nutritional value of water hyacinths and feeds, 14806
composition re metabolism of glucose-6-^{14}C in carp, 14850

Diet, cont.
digestibility of,
nutrients in semi-purified rations by catfish in steel troughs, 15509
sunflower, lupin, rye and food mixture by carp, 14863
effect on glucose, glycogen and lipids in carp, 14849
fatty acids, essential-,
deficiency symptoms in rainbow trout, 14117
growth, feed conversion and deficiency symptoms in rainbow trout, 15120
lipid metabolism and fatty acid composition of rainbow trout, 15118
feed, catfish-, effect of diethylstilbestrol in, 15593
fish-, commercial-, bacterial counts of, 14297
lipids,
and temperature re growth, metabolism and composition of catfish, 14892
effects on growth, conversion, lipid and fatty acid composition of catfish, 15116
nutrition,
of fishes under intensive production, 14316
research, priorities in, 15369
Oregon pellet production formulations, mineral composition of, 15552
phytophagous fishes, role of infusoria in food of larvae, 14871
plants, aquatic, as ingredients in catfish feeds, 14688
protein efficiency re amount in rainbow trout feed, 15073
ration, trout-; krill- and "leda" flour in, 14381
re conversion, maintenance and assimilation for walleye, 15621
re visceral granuloma in brook trout, 14693
vitamin,
-A requirement in goldfish diet, 14448
fortification, effect in Auburn No. 2 fish feed, 14638
requirements, minimum- for carp, 14834

Disease,
Aeromonas,
infection in brown trout of Loch Leven, 15308
liquefaciens,
antibody detection in fish via fluorescent antibody technique, 15087
detection with immunofluorescent techniques, 15517
from freshwater fishes, re drug sensitivity, 14837
isolation from bass eggs, fry, 14372
punctata, antigen production in carp for immunization against, 14315
salmonicida,
from sablefish and salmon, 14610
virulence and persistence of forms inoculated into coho, 15085
antibody accumulation in carp re intervals of injection, 15003
Argulus alosae, on dying menhaden in Connecticut River, 15598
bacterial,
fish pathogens, in vitro studies of nifurpirinol (P-7138) against, 14705
gill-, studies in hatchery-reared salmonids, 14949
hemorrhagic septicemia of carp, furazolidone for control of, 14617
bothriocephalesis, use of phenasal against, in carp, 15438
branchiomycosis, development of fungus agent of, 15488
Ceratomyxa shasta, control by treating hatchery water supplies, 14703
channel catfish virus,
a new herpes virus of ictalurids, 14862
histopathologic changes in, 15077
in southern U. S., 15514
research at Auburn University, Alabama, 14797
tissue distribution of, 14812
Chondrococcus columnaris, antibody- and immune response of salmonids to, 14495
Clostridium botulinum, tank trout as carriers of, detection of, 14624

Disease,
columnaris,
seasonal distribution in river fishes, from specific agglutinins, 15081
susceptibility of juvenile salmonids to bacterium of, 14758
crooked vertebral columns in juvenile Atlantic menhaden, 14547
epidermal lesions, incidence in fish of N. E. Irish Sea area, 15307
fish-,
study in USSR, 14422
therapy: past, present, future, 15383
gas-bubble-, of,
13 fishes in contact with thermal effluent, 15506
salmonids, review, 14950
gill-, of the carp, etiology and epizootology, 15001
gyrodactylesis, use of malachite green against, in carp, 15437
hepatoma, resistance and defense in older rainbow trout, 15070
hydrocephalus in northern pike fry, Netherlands, 14262
Ichthyophthirius,
infection of Ugandan fish, 15562
review of control methods, 15563
IHN,
pathogenesis of, 15207
survey for, in Washington salmon, 15556
immunology, phagocytosis of bacteria by carp kidney cells, 15004
immunity, some factors of, in fish, 14966
inflammation of carp swimbladder, characteristics of, 15439
inflammatory response of rainbow trout, 14267
IPN virus,
effect of actinomycin D on multiplication of, 14615
epidemiological model for passive transfer by homeotherms, 15389
first isolation from epizootics in Japan, 14843
frequencies of isolation from brook trout, 14246
isolated from white suckers, 14963
of rainbow trout in Japan, pathogenicity of isolants, 14845
of salmonids in Ontario, 14506
lymphocystis, new records in 4 E. Pacific fishes, 14767
monolayer tissue culture,
of bream kidney tissue, 15093
preparation from carp gonads, 15403
myxobacteria, selected-, pathogenic for fish, studies on, 14949
Myxosoma cerebralis,
extraction and study of spores, 14361
spread into trout populations of Michigan, 15098
nephroblastoma, spontaneous, in a hatchery rainbow trout, 14853
nifurpirinol, efficacy, toxicity and residues in salmonids, 15301
nitrogen gas bubble disease in hatchery receiving high-dam water, 14226
parasitosis, determination of metrifonat residue after treating fish with masoten, 14889
pathogens, fish-, bacterial and fungal, effect of 2 iodophors on, 15545
pathological,
anatomy, role in ichthyotoxicology, 14431
effects in formalin-treated rainbow trout, 15152
red-disease in northern pike fry, Netherlands, 14262
"red mouth" enzootic in hatchery rainbow trout due to vibrio, 15306
red rot, histological changes in organs of sick fish, 14965
"red sore", due to Epistylis on fish in southeast U. S., 15515
red-spot alteration of peroxidase and cytochrome oxidase in blood of carp with, 15485
research in fish, 14414
Saprolegnia, therapy for trout eggs infected with, 15557
saprolegniosis, data on species composition and ecology of fungal agents in USSR, 14951

Disease, cont.
soft-egg-, of fishes, 14335
swimbladder-,
of the carp,
epizootic in Netherlands, 15013
epizootology, diagnosis and prophylaxis, 15000
properties of organ lipids in carp with, 15235
Trichodina, method for microscopic preparations from preserved fish, 14964
tumors, skin,
comparison in 3 flounders, 14494
in eel, re differentiation and growth inhibition re quinine sulfate, 15568
UDN,
epizootic of Atlantic salmon in Brittany, 15107
failure to detect epithelial auto-antibodies in sera from diseased fish, 14783
present state of knowledge on, 14852
re recruitment of salmonid populations of Lough Erne waters, 14787
vibrio-, in wild Norwegian fish, 14644
vibriosis,
hematological effects in juvenile chinook, 14373
in fish, 15419
viral-host interactions in RTG-2 cell line, effect of zinc on, 14376
virus,
-caused epizootic of rainbow trout in Minnesota, 14735
isolation from asymptomatic carrier fish, 15175
viruses,
(OSV, SRCV, and IHN) antigenic relationships by cross neutralization, 14541
salmonid, virucidal activity of 2 iodophors, 15034
visceral granuloma in brook trout, 14693
whirling, spread of Myxosoma cerebralis into trout populations, Mich., 15098

Distribution,
Basidiobolus ranarum, fungus, in fish, amphibians and reptiles, 14486
bass,
largemouth, fingerlings in Lake Nacimiento, Calif., 14424
Roanoke, in North Carolina, 15525
striped,
first records in British Columbia waters, 15154
re river flow in Sacramento-San Joaquin estuary, 15579
X white, occurrence and growth in Rappahannock River, Va., 14459
carp in marine environment, anomalous occurrence of, 14505
Chondrococcus columnaris disease, seasonal, in river fishes from specific agglutinins, 15081
dace, blacknose, in southeastern Nebraska, 14314
depth-, of some small flatfishes off northwest coast of U. S., 14230
Diphyllobothrium spp., occurrence in Alaska, 14629
ecological-, of fishes of Moapa River, Nevada, 15574
euphausiids of Washington coast, vertical, diel changes, 15461
fish-, effects of thermal effluent on, in Lake Catherine waters, Ark., 15505
fishes,
freshwater, of Ecuador, prospects for propagation, 14318
in Lake Monona, Wis., re thermal effluent, 15607
of Nemaha Basin, Nebraska, 14313
flounder, broad, in So. Carolina coastal waters, 14556
hake,
southern, in Georgia estuaries, 15590
spotted, in Georgia estuaries, 15590
herring,
Atlantic, larval, along western Gulf of Maine, 14985
juvenile, in Potomac River, 14337
interactions between coho and native fishes in small lake, 15548
jack, cottonmouth, added to Calif. marine fauna, 15469

Distribution, cont.
macrophytes, in southern Michigan marl lake, 14464
marlin,
blue, in Atlantic Ocean, 14983
white, in Atlantic Ocean, 14983
menhaden, Atlantic, young, in White Oak River Estuary, N.C., 14406
minnow,
fathead, in Chesapeake Atlantic slope drainages, 14546
sheepshead, factors affecting locally, 14732
nitrogen fixing bacteria in,
fresh waters, 14855
sea waters, 14856
Nocomis biguttatus species group, 14643
oligochaete worms in Estonian lakes, 15443
orientation of young freshwater fishes in a photobarogradient chamber, 14874
parasites, fish-, in Poland, 15139
perch, white, in Nebraska, 14454
phytoplankton, vertical, mathematical model of, 14924
pikeperch, European, in Sea of Azov, re environmental factors, 14913
pupfish, Red River, 15397
roach, Azov, re environmental factors, 14913
rockfish, coral-red, off Southern California, 15495
salmon,
chinook, fall-, from Columbia River hatcheries, in ocean re yield, 14991
sockeye, immature, in No. Pacific offshore waters, 1956-67, 14633
scorpionfish, Calif., reoccurrence in Monterey Bay, 15466
surfperches, 4-, southern geographical records for, 14816
survey procedure for evaluating trout stream fisheries, 14657
territory conquest by brown trout re initial population density in artificial brook, 14901
^{65}Zn and stable Zn, in experimental marine ecosystem, 14764

Drugs,
actinomycin-D, effect on multiplication of IPN virus, 14615
aminobenzyl penicillin, sensitivity of Aeromonas liquefaciens to, 14837
2-amino-4-phenylthiazole, surveys on anesthetic properties on carp, 15270
antifungus compounds, 8-, tested for control of Saprolegnia on trout eggs, 15557
betadine,
effect on bacterial and fungal fish pathogens, 15545
virucidal activity to salmonid viruses, 15034
chloramine-T, for control of Ichthyophthirius, 15563
chloramphenicol, sensitivity of Aeromonas liquefaciens to, 14837
chlortetracycline, sensitivity of Aeromonas liquefaciens to, 14837
devermine, antihelminthic, toxic effect on fish, 14400
diethylstilbestrol in feed, effect on catfish, 15593
eserine, effect on phenol intoxication of crucian carp, 15121
formalin,
for control of Ichthyophthirius, 15563
pathological effects in treated trout, 15152
treatment stress in salmonids, 14978
fradiomycin, sensitivity of Aeromonas liquefaciens to, 14837
furazolidone,
for control of bacterial hemorrhagic septicemia of carp, 14617
sensitivity of Aeromonas liquefaciens to, 14837
gonadotropin,
salmon, effect on oocyte maturation in catfish, 15217
sperm from injected males for fertilization of pink salmon eggs, 15028
kanamycin, sensitivity of Aeromonas liquefaciens to, 14837
malachite green,
-formalin mixtures for control of ich, et al., 14706
used against Gyrodactylus in carp, 15437

Drugs, cont.
masoten, determination of metrifonat residue after treating fish for parasitosis, 14889
melatonin, locomotor response to, in juvenile sockeye, 14630
methylene blue, for control of Ichthyophthirius, 15563
MS-222,
-anesthesia and locomotor restraint, effects on salmon reactions to pH and CO_2 changes, 15160
effect on,
blood sugar and liver glycogen in rainbow trout, 14771
nitrogen excretion of bluegill, 14280
levels in trout blood in anesthesia, branchial irrigation and recovery, 15542
some responses of brown bullhead to, 14708
nifurpirinol,
efficacy, toxicity and residues in salmonids, 15301
(P-7138), against bacterial fish pathogens, in vitro, 14705
sensitivity of Aeromonas liquefaciens to, 14837
nitrofurazone, sensitivity of Aeromonas liquefaciens to, 14837
phenasal,
antihelminthic, toxic effect on fish, 14400
used against Bothriocephalus in carp, 15438
phenylhydrazine-induced anemia in chinook salmon, 14780
phosphacol, effect on phenol intoxication of crucian carp, 15121
pituitary injection in propagation of grass- and silver carp, 14865
proserine, effect on phenol intoxication of crucian carp, 15121
quinaldine sulfate, efficacy and residues re striped bass anesthesia, 14680
quinine sulfate, effect on redifferentiation and inhibition of eel tumors, 15568
serotonin, locomotor response to, in juvenile sockeye, 14630
streptomycin, sensitivity of Aeromonas liquefaciens to, 14837
sulfamonomethoxine, sensitivity of Aeromonas liquefaciens to, 14837
sulfisoxazole, sensitivity of Aeromonas liquefaciens to, 14837
tetracycline, sensitivity of Aeromonas liquefaciens to, 14837
urethane, - anesthesia and locomotor restraint, effects on salmon reactions to pH and CO_2 changes, 15160
wescodyne,
effect on bacterial and fungal fish pathogens, 15545
virucidal activity to salmonid viruses, 15034

Ecology,
adaptive variation in swimbladder length and volume in 4 daces, 15074
bacteria associated with surface of stream-incubating Pacific salmon eggs, 14601
benthic community structure from diversity indices, Keystone Res., Okla., 15235
biological early warning system re industrial pollution, 15141
biology of the estuary, 15037
bluegill, under temperature and zinc stress, mortality curves of, 15578
channelization of N. C.'s coastal streams, effects on fish populations, 15502
communities, aquatic, response to spills of hazardous materials, 15451
community metabolism in Bay of Quinte and Lake Ontario, 14755
concentration of food organisms re rate of consumption by fish larvae, 14528
croaker, in 2 Gulf of Mexico nursery areas, 15404
dace, longnose, notes on a lake-dwelling population, 15153
distribution,
and behavior of fishes in Lake Monona, Wis., re thermal effluent, 15607
of fishes of Moapa River, Nevada, 15574
ecological,
efficiencies, food and feeding selectivity of blackstripe topminnow, 15417
systems, nutritive quality of food in, 15245
ecostructural studies on olfactory organ of seatrout, 15476

Ecology, cont.
ecosystem,
alteration by mosquitofish predation, 14869
destruction in Great Lakes and reconstruction possibilities, 15412
experimental-, marine-, distribution of 65Zn and stable Zn, 14764
fishery interaction in a body of water, modelling of, 14864
freshwater-, lake-, nutrient composition of, 15134
stream-, migration and metabolism in, 14251
ecosystematic study of South River, Va., 15550
ecosystems,
lotic, accumulation and persistence of DDT in, 14976
marine, exploitation effects on interspecific relationships, 14989
effects of,
agricultural pollution on recreational uses of surface waters, 15391
chemicals on aquatic life, 15300
floods on trout in Sagehen Creek, Calif., 15583
heated waste waters on some microorganisms, 14773
hydrogen sulfide on fish eggs and fry, 15314
stocking salmonids in barren lakes, 15325
thermal effluent on,
aquatic life in E. Texas reservoir, 15504
fish distribution in Lake Catherine waters, Ark., 15505
environmental,
alterations re future shad runs, St. John's River, Fla., 14947
contamination by persistent pesticides, 15444
control of teleost reproduction, 14789
factors re distribution of pikeperch and roach in Sea of Azov, 14913
sources of variation in length and weight of rainbow trout, 15142
stress, responses of teleosts to, 15458
fish,
and fish habitat, effect of sediment on, 15402
eggs and larvae of upper Chesapeake Bay, 15046
of sockeye nursery lakes of world, 15326
species diversity re stream order and conditions, Plum Creek basin, 15396
fishery resources of Lake Erie, effects of exploitation, introductions and eutrophication, 15346
fishes,
associated with pelagic sargassum complex, 15366
Hawaiian-, reef-, activity at dawn and dusk, 15490
northern-, marine-, demersal-, food resource division among, 15423
of South Coast Basin, Ore., and water requirements, 15549
fluctuation, water-, detrimental influence on trout streams, 14341
food,
density re growth and behavior of plaice larvae, 15288
webs, unstructured-, marine-, and "pollutant analogues", 15499
Georgia coastal fishes, 14986
habitat,
preferences of harlequin darter in Texas, Okalhoma, 14750
selection and spatial interaction by juvenile steelhead and chinook, 15038
utilization by trout in Idaho streams, 15145
herring,
blueback, salinity tolerance of young, 14739
Pacific, effect of intertidal exposure on egg survival and development, 15614
industries, forest-based-, impact on freshwater-dependent fish resources in New Brunswick, 15602
interactions between coho and native fishes in small lake, 15548
killifish, diamond, 14485
Lake Ontario, biology studies, bibliography, 15032
littoral fauna, effect of water level changes on, in Llyn Tegid, 15367
logging and road construction, effects on N. California streams, 14725

Ecology, cont.
macroinvertebrates, Bay of Quinte and Lake Ontario, associations and species, 14753
mercury,
accumulation in food chains, 14861
occurrence and effects in ecosystem, 14900
microbial communities of fresh water, structure and function of, 14491
micro-habitat pH differences from those of surrounding water, 14410
microorganisms growing on peled spawn, 14776
of silverjaw minnow, 14876
pesticide,
effects on non-target species, 14717
residues of 20 Mississippi delta lakes, 14675
pike, northern, significance of vegetation to spawning, 15604
polyodontids, 14382
predator-prey interactions, detection of toxicant effects on, 15195
pupfish, Red River, 15397
rechanneling, annual-, effect on stream fish population, 15169
recovery of damaged streams, 14359
road salt as polluting element, 14722
salmon, chum, of South Kuril' Islands, 15224
salmonid,
communities in oligotrophic lakes, introduction to symposium on, 15283
community,
culturally unstressed, characteristics in Keller Lake, 15328
of Lakes, effects of exploitation, introductions or eutrophication; or future of, 15330, 15331, 15332, 15333, 15334, 15335, 15336, 15337, 15338, 15339, 15341, 15342, 15343, 15344, 15346, 15347, 15348, 15349, 15350, 15351, 15352, 15353
salmonids of recently glaciated lakes, systematics of, 15282
segregation between,
cutthroat and Dolly Varden populations, 14496
daces in Mink River, Manitoba, 15536
shad, gizzard, re Elephant Butte Lake, N. M., 14934
shiner, coastal, in No. Carolina waters, 14453
spot, in 2 Gulf of Mexico nursery areas, 15404
stream damage from manganese strip-mining, 15507
submerged environment of Fla., its future re dredging, filling, public trust, 14674
succession, factors of, in oligotrophic fish communities of the Great Lakes, 15327
temperature requirements of salmonids re feeding, bioenergetics, growth, behavior, 15214
threatened freshwater fishes of U. S., 15172
trout,
cutthroat-, and Dolly Varden, feeding behavior and interaction of, 15259
streams, 4, in Normandy, 14904
use of disposable beverage cans by fish in San Joaquin Valley, 15600
weed control and herbicides, toxicological effects on fish and other organisms, 14583

Economics,
cost of 2 strains of trout stocked in California lake, 14819
fish production in Ark. in 1969 vs. other states, 14677
impact of fish expenditures in Grand County, Colo., 14310
1970 National Survey of Fishing and Hunting, BSF&W, 15471
significance of upstream aquatic resources of West Coast, 14539

Electricity,
electric fishing, high-power pulse generator for, 15309

Electricity, cont.
electrofishing,
and its principles, bibliography, 14479
effect on invertebrates of English stream, 14907
for determining fingerling bass distribution in Calif. lake, 14424
systems, DC-, portable, guideline for, 14398
electro-osmosis, a new technique for concentrating viruses from water, 15381
shocked common shiner, recovery re electric energy, 15597
use with shrimp trawl in Lake Michigan, 14956

Embryology,
bass, white, observations on early development, 14327
carp,
accumulation and activity of I^{131} during development, 15405
from adhesive and degummed eggs, comparative evaluation of, 14921
zinc concentration in early stages, 14515
development,
and growth of bluegill thru one year, 15067
of olfactory apparatus in cutthroat trout, 15179
developmental rates and temperature tolerances of Red River pupfish, 15112
eggs,
herring-, amount of carotenoid pigment in, 15442
of cunner and tautog, identification by immunodiffusion, 15040
eggshell building and changes during germ development in brown trout, 15390
embryogenesis, initial-, in rainbow trout, significance of egg carotenoids and vitamin A, 15114
embryogeny of grass carp, variability in rate of, 14385
goldfish, glycogen dynamics in early embryogenesis, 14523
herring, Pacific, effect of intertidal exposure on egg survival and development, 15614
malformations in fish development due to hexachlorocyclohexane, 14434
nitrogenous metabolites of fish eggs and larvae, 14872
ontogeny, fish-, effect of phosphorus halides on, 15125
preparing teleost embryos for study, 14712
salmon, Pacific, bacteria associated with surface of stream-incubating eggs, 14601
shell membrane of fish egg, amino acid composition and solubilization of, 14636
silverside, Mississippi, developmental rates and salt tolerance, 14438
water exchange in the northern pike egg, 15047
whitefish, accumulation and activity of I^{131} during development, 15405
yolk sac syncytium of muskellunge, giant nuclei formation in, 14465
zinc localization in carp spawn, embryos and larvae, 14775

Equipment,
apparatus, modular-, controlled-temperature-, for eggs and fry, 14252
artificial reef technology, recent developments in, 14258
basket for washing benthological samples, 14403
biopsy, for obtaining fish muscle samples in field, 14298
bottle, Mariotte, lightweight-, for field, laboratory, and hatchery, 14371
box, lightweight-, live-, for fishery work, 15605
cage,
for exposing aquatic animals to bottom sediments, 15104
rotable, for high-density aquaculture, 14701
circulating seawater system for studies with crabs, 14716
cleaner, hatchery-trough-, 14365
collector, plankton, diver-operated-, 15155
collectors, epifaunal-, 2, simple and durable, 14299
counter,
plankton-, automated, trials with, 15431
simple-, electronic-, smolt-, 15205
culture system, continuous-, recirculating-, for planktonic copepods, 15170

Equipment, cont.
dispenser for Winkler's dissolved oxygen reagents, 14770
electrodes, underwater-, for electrocardiography of eel, 14832
electrofishing systems, DC-, portable, guideline for, 14398
fail-safe device for laboratory aquaria, 14375
feeder,
electrically-operated-, for use in salmon rearing, 14261
fish-, battery-powered-, automatic-, for use in remote areas, 14658
feeders, automatic- and demand-, design for experimental fish, 15317
filters, biological, for increased production, 15513
generator, high-power-, pulse-, for electric fishing, 15309
girthometer, fish-, for field use, 14619
grader, catfish-, development and operating efficiency of, 15090
hydrocappameter for field measurement of conductivity, temperature and illumination of water, 14516
hydrofoils, removable, for surface and bottom sampling with one otter trawl, 14686
incubator,
fish-egg-, inexpensive design, 15566
pelagic-egg-, for use on ships, 14920
infrared photo technique for studying gill vessels, 15039
light to collect and separate zooplankton, 15581
locomotion detector, inductive-, for diurnal activity studies in fish, 15123
Maros-Schulek technique for measuring CO_2 and respiratory quotient in tilapia, 14504
metering device for chemicals in intermittent-flow bioassays, 15603
monopolar lead of electrocardiograms from body surface of eel, 14831
net-board for setting beach seines from small boats, 14774
pellet dispenser, automatic-, for experimental feeding of fishes, 15558
plankton splitter, modified-, Folsom-, for analysis of meter net samples, 14660
pools, plastic-, effects of water hardness on fish production in, 14342
recirculation unit, compact, for rearing and maintenance of fish, 15430
recorder, digital, for monitoring oxygen in fish tank, 14296
respirometer, for pollutant- and pesticide effect on O_2 use of estuarine fish, 15527
rotating closed vessels for determining oxygen consumption by fish eggs, 14873
salinity indicator for use in marine fish farming, 15122
sampler,
Kajak-, bottom-, new model, plus sampling techniques re zoobenthos, 14822
quantitative, for aquatic phytomacrofauna, 14502
shallow-water-, core-, 14374
stream-, square-foot-, bottom-, procedure for use, 14353
screen, traveling for removal of debris from rivers, 14772
seine, plankton-, purse-, for sampling anchovy larvae, 15491
separator, for quantitative count of meiobenthos, 14927
sorting device for salmonid eggs, 14370
stirrer, battery-powered-, magnetic-, for field use, 15571
sugar flotation and dye for sorting benthic samples, 14441
tags, internal-, anchor-, used in pilot shrimp tagging project, 15177
tank, environmental-control-, for study of salmon growth and metabolism, 14825
temperature control system for recirculation fish-holding facilities, 15432
transmitter, for behavioral studies on reservoir fishes, evaluation of, 15528
trap,
inverted-, funnel-, used to capture benthos leaving bottom of Bideford River, P.E.I., 15626
polypropylene-, light-, for aquatic invertebrates, 14940
trapnet, for sampling shallow-water habitats, 15137
trawl, shrimp-, used with electricity in Lake Michigan, 14956

Equipment, cont.
UV for attracting insects to caged bluegill, 14360
vessels, research, of NMFS, 14368

Estuaries,
Biloxi Marsh Complex, La., sport fishes in, 15027
biology of, 15037
brackish water ponds for catfish culture, 14354
Chesapeake Bay, upper-, fish eggs and larvae of, 15046
commercial and recreational resources of, southern U. S., 14355
cycling of elements in, 15496
Discovery Bay, Wash., effects of trawling in, 15376
Dnieper-Bug, reproduction of Black Sea pikeperch in, 14931
fishes of, respirometer for measuring effect of pesticides and pollutants on O_2 use of, 15527
Georgia, occurrence and food habits of 2 hakes in, 15590
Great South Bay, N.Y., comparison of shore-zone fishes over different bottoms, 14613
Gulf- and southeast Atlantic coast-, effects of pesticides in, 15455
Long Pond, Newfoundland, life history of winter flounder, 14292
Louisiana estuaries, description and biology, 14436
Monterey Bay, predation on salmon by sea lions, 14817
pesticides and PCB's in, 14586
phytoplankton, effect of NTA on growth and metabolism of, 15166
Sacramento-San Joaquin,
characteristics of sturgeon population via tagging, 14941
distribution and abundance of young striped bass re river flow, 15579
migrations of,
striped bass, 1965-67, 14423
tagged sturgeons in, 14939
Sheepscot, Maine, retention of larval herring within, 14984
Sixes River, Ore., algae growth as cause of tag loss from chinook, 14242
thermal pollution, responses of some fishes to increasing gradients, 15459
Tomales Bay, Calif., maturity and fecundity of white seaperch, 14244
Vermilion Bay, La., sampling of postlarval shrimps, plus temperature and salinity data, 14412
West Bay, Texas, phytoplankton production in natural and altered areas, 14407
White Oak River-, N.C.,
abundance and distribution of young menhaden, 14406
description of young menhaden in, 14651
Yaquina Bay, Ore., biology of pile perch, 14933
young fishes of, effects of increased temperature on, 15532

Farm ponds,
N-fixing potential of plankton in 2 farm ponds, 15238

Fertilization,
ammonia, anhydrous-, use in fisheries management, 14347
fertilizers, inorganic and organic matter, effect on macrobenthos in ponds, 14346
Great Central Lake,
effect on,
juvenile sockeye, 14647
primary production, 14646
stock of zooplankton after fertilization, 14648
lime for fish-breeding ponds, 14926
nitrate and phosphate addition re eutrophication of experimental lake, Canada, 14762

Food habits,
anchovy, larval, swimming and feeding behavior of, 15492

Food habits,
bass,
largemouth,
exploitation of crayfish in Ohio pond, 14714
in Murphy Flowage, Wis., 14303
Roanoke, in North Carolina, 15525
white, in Beaver Reservoir, Ark., 14324
bighead, 14738
bluegill,
daily feeding rates determined by radioisotopic method, 14340
larval, first food, 15171
bowfin, in eastern Texas, 14723
buffalo,
bigmouth, from 4 Okla. reservoirs, 14689
smallmouth, from 4 Okla. reservoirs, 14689
carp,
grass, in Russian farm ponds, 14737
in 5 Okla. reservoirs, 14662
silver, 14738, 14740
young-, ^{14}C for determination of food consumption, 14744
catfish,
channel, and feeding chronology in Conowingo Reservoir, 14663
flathead, adult, in Okla. reservoirs, 14665
consumption of Oligochaeta by fishes and invertebrates, 14390
crappie, white, adult-, in Conowingo Reservoir by season, 14877
croaker in brackish water ponds, 14325
darter, orangebelly, 15241
feeding,
behavior and interaction of cutthroat trout and Dolly Varden, 15259
frequency for a maximum daily ration, re 6 fishes, 14836
selective-, of aquatic organisms, model of, 14928
flounder, winter, surges into intertidal zone, 14757
food,
availability to Lake Ladoga pikeperch, 15233
consumption of bluegill population in Wyland Lake, Indiana, 15209
feeding selectivity and ecological efficiencies of blackstripe topminnow, 15417
resource division among northern marine demersal fishes, 15423
gar,
Florida, from 5 central Florida lakes, 14667
in eastern Texas, 14723
longnose, from 5 central Florida lakes, 14667
hake,
southern, in Georgia estuaries, 15590
spotted, in Georgia estuaries, 15590
herring, lake, in Torch Lake, Michigan, 15577
mackerel, Pacific, laboratory study of particulate and filter feeding of, 15497
marlin, striped, off Mexico and S. Calif., 14935
perch,
pile, in Yaquina Bay, Ore., 14933
yellow, larval, first food, 15171
phytophagous fishes, role of infusoria in food of larvae, 14871
pike, northern, in Kremenchug Reservoir, USSR, 14929
piscivorous fishes in Lake Michigan, utilization of alewives, 14730
ration size and digestion in largemouth bass, 14805
re temperature requirements of salmonids, 15214
sailfish, off Mexico and S. Calif., 14935
salmon,
chinook, juvenile in Columbia River re thermal pollution, 14721
juvenile-, size re their prey, 14824
Pacific-, in Bering Sea, summer of 1966, 14827
sockeye, juvenile, summer food of, re zooplankton population, 14988

Food habits, cont.
sculpin, reticulate-, and torrent-, occupying same habitat, 15198
shad, American, in St. John's River, Fla., 14947
shiner, emerald, larval, first food, 15171
smelt, rainbow, larval, first food, 15171
studfish, northern, in Missouri Ozarks, 15197
sturgeon, spiny, changes and role in improvement of Aral Sea, 14389
sucker, white, larval, first food, 15171
sunfish, redbreast, in SE North Carolina, 15524
trout,
brown, in Irish waters, 15043
winter food in 3 high Sierra Nevada lakes, 15465
tuna, skipjack, in North Carolina waters, 15447
whitefish, lake-, in Torch Lake, Michigan, 15577

Genetics,
allelic isozyme synthesis, preferential inhibition of, in sunfish hybrid, 14886
bass, largemouth, evaluation of 3 strains stocked in Alabama ponds, 15503
biochemical variation at 6 loci in 4 stocks of rainbow trout, 15587
chromosome numbers of fishes, 14266
chromosomes, plaice-, method for display of, 15206
cyprinid hybrid (Notropis pilsbryi X Chrosomus erythrogaster), new, from Okla., 14782
electrophoretic investigation of Scorpaenidae, 14987
esterases, tissue-, of crappies, comparison by electrophoresis and selective inhibitors, 14799
genic polymorphism of,
blood proteins from white marlin, 14936
tetrazolium oxidase in bluefin tuna, 14243
giant nuclei formation in yolk sac syncytium of muskellunge, 14465
hybrid,
embryos, intergeneric-, centrarchid-, development of, 14437
green sunfish X largemouth bass, isozyme analysis of, 15052
redear sunfish X bluegill, heterosis in swarm, 15054
sunfish,
inheritance of isozymes in, 15068
redear X sunfish, green, potentials in pond management, 15099
sunfish populations, supplemental feeding of, 14439
swarm of Gambusia, competition and isolation mechanisms, 14426
hybrids,
catfish, salinity tolerance of, 14445
natural, between brown trout and Atlantic salmon, 15203
percid-, intergroup-, survival of, 14482
tilapia-, electrophoresis of sera from, 15006
inbred rainbow trout fry re abnormal body curvatures, 14981
inheritance of,
albinism in rainbow trout, 15319
esterases in crappies and their hybrids, 15356
karyotypes of the family Esocidae, 15262
karyotypic analysis of 2 sympatric killifishes, 14785
LDH,
allozymes, distribution properties of, in fathead minnow, 15267
isozyme, nervous-system-specific, evolution in fish, 14952
MDH loci, homologous-, linkage relationships between, in teleosts, 14953
multiple cistrons for LDH and MDH and achromatic bands in round whitefish, 14885
mutant, color-, of chain pickerel, 15196
of MDH isozymes in walleye skeletal muscle, 14238
polymorphism, albumin-, in white perch, 14891
selection and conservation of genetic resources of fish, FAO report, 15042
sources of variation in length and weight of rainbow trout, 15142

Genetics, cont.
subpopulations of Hawaiian striped mullet, variations of nuclear eye-lens proteins and weights, 14794
sucker, white- and longnose-, biochemical and cytological study of large and dwarf forms, 14759
tetraploid origin of the karyotype of catostomids, 14868
transferrin types,
distribution and gene frequency in stock-bred- and amur carp, 15408
re external characters of carp, 14535
variability of buffalofishes in Arizona, 14749

Habitat improvement,
artificial reef technology, recent developments in, 14258
carp,
grass, weed control in India, 14745
silver, in Russian ponds, 14740
cover retention re angling quality, evaluation in Calif. lake, 15014
effects on trout harvest and crop in Pigeon River, Mich., 15421
eutrophication, the problem, detection and extent of, 15026
herbivorous fish, used for amelioration in Europe, 15017
lake renewal; correction techniques, demonstration methods, successes and failures, 15024
rapids, artificial, re creation of food supply for trout in Carpathian mountains, 14930
reconstruction possibilities re destruction of ecosystem in Great Lakes, 15412
rehabilitation of Atlantic salmon in East River, Sheet Harbor, N.S., 15601
responses of brook trout in Lawrence Creek, Wis., 14306
sediment in Michigan trout stream: source, movement and effects, 14589
weeds, aquatic, control with white amur, 15065

Harvest,
after 5-year fishing ban in Mill Lake, Mich., 15374
anchovy, northern, age and length in Calif. reduction fishery, 14946
angling,
intensive, re dynamics of fishes in Alabama pond, 14457
quality re cover retention, evaluation in Calif. lake, 15014
bass,
largemouth in Murphy Flowage, Wis., 14303
striped, winter gill-net catches in Rappahannock River, 14690
Black Lake, Canada, limnology and fishery biology of, 15016
Bureau of Commercial Fisheries report for 1969, 14614
cod, distribution of fishing in North Atlantic, 15567
concentration indices, use in fisheries, 14994
creel,
and use history, 16-yr-, of Noontootla Creek, re changing regulations, 14687
survey of Okla. lakes re improvement of creel survey design, 14679
drum removal from Lake Winnebago, Wis., evaluation of, 14317
effects on salmonid community of Lakes, 15330, 15331, 15332, 15333, 15334, 15335, 15336, 15337, 15338, 15342, 15343, 15344, 15345, 15347, 15351
estimates, biased-, from postal survey of a sport fishery, 15174
exploitation effects on interspecific relationships in marine ecosystems, 14989
fisheries of 5 Precambrian lakes of Saskatchewan, 15365
fisherman survey, Madison Firehole Rivers, Yellowstone Park, 1969, 15190
fishing,
effects on Atlantic menhaden stock, 15180
effort, exposition on definition of, 15488
Folsom Lake, Calif.,
determined by roving creel census, 14938
non-reporting of tagged catch by anglers, 14421
guide to 28 public fishing lakes, Kentucky, 15533
herring, Pacific, 15377

Harvest, cont.
in SCOL lakes, Canada, review of management approach to, 15324
IPSFC Annual Report for 1971, 15372
menhaden, Atlantic, purse seine fishery, 1940-68, 14405
Michigan's 1971 sport fishery, 15385
1970 National Survey of Fishing and Hunting, BSF&W, 15471
Nushagak sockeye run, 1908-66, 14404
polyodontids, 14382
salmonids planted in Ontario lakes, 15076
significance of upstream resources of West Coast, 14539
sport fishery,
for silver redhorse in Flint River, Alabama, 14683
Klamath River, plus salmonid migration data, 15069
Michigan's 1970, 14460, 14461
Shasta River, 1970, including steelhead, 15051
winter-, survey in warm-water discharge of Md. power plant, 15320
sportfishing-, catfishes in ponds with daily feeding, 14344
Tilapia aurea, by fishermen in Lake Parker, Fla., 14333
trap nets, Wisconsin-type, 10-ft, relationship between lifts and catch of, 14678
trawling, effects in Discovery Bay, Wash., 15376
troll fishery, effect on yield of fall chinook from Columbia River hatcheries, 14991
trout,
brown,
biology re commercial size in Karelian lakes, 14912
questionnaire for assessing angling potential of waters, 15242
in Hidden Valley Lake, Va., 14352
in Llyn Alaw, Wales, 15355
in Pigeon River, Mich., effects of stream improvement on, 15421
in Sagehen Creek, Calif., 15582
rainbow,
2 domestic strains stocked in Calif. lakes, 14819
infected with Sanguinicola davisi, 14435
steelhead, winter fishery on N. Fork of Stillaguamish River, 14727

Indentification,
Apophallus brevis, parasite of yellow perch, 14948
bass, Roanoke, in North Carolina, 15525
char, Arctic, characteristics of 2 populations in Swedish lake, 15161
Chironomidae of So. Dakota, 14655
classification of living fishes, modern concepts of, 14910
cyprinid hybrid (Notropis pilsbryi X Chrosomus erythrogaster), new, from Okla., 14782
dace, speckled, a new species from Big Smoky Valley, Nev., 15529
darters, johnny and tessellated, and hybrids, comparison of, 15620
dimorphism, sexual, re chromatin patterns in fishes, 14625
eggs,
and larvae of fish, in Upper Chesapeake Bay, 15046
of cunner and tautog by immunodiffusion, 15040
fishes,
freshwater, of Ecuador, prospects for propagation, 14318
of Nemaha Basin, Nebraska, 14313
herring stocks in Canadian waters, use of otoliths, 15613
Hybopsis lineapunctata, new cyprinid from upper Alabama River system, 14321
hybrid, green sunfish X largemouth bass, isozyme analysis of, 15052
hybrids,
natural, between brown trout and Atlantic salmon, 15203
tilapia-, electrophoresis of sera from, 15006
marlin, white, genic polymorphism of blood proteins from, 14936
Nocomis biguttatus species group, 14643
of algae ingested by tilapia, culturing method for, 15531

Identification, cont.
oligochaete worms of Chud-Pskov Lake, 15477
parasites of cyclostomes and teleosts of Poland, 15139
perch, white, albumin polymorphism in, 14891
polyodontids, 14382
runs of even- and odd-year salmon from scales, 15147
salmon,
Atlantic, American and European, thru electrophoresis, age, length, parasites, 15075
chinook, spring-, races thru scale patterns, 14229
salmonids,
anadromous-, juvenile-, in Pacific northwest, field key, 15119
of recently glaciated lakes, systematics of, 15282
Salvelinus, osteological characters re taxonomy, 15222
Scorpaenidae, electrophoretic investigation of, 14987
Sebastes rufinanus, new scorpaenid from Calif. waters, 15632
shiner, common, status in Kentucky, 15523
sunfish, hybrid, allelic isozyme synthesis, preferential inhibition of, 14886
systematics of Etheostoma camurum and E. chlorobranchium sp. n., with discussion of Nothonotus, 15631
tilapias, hemoglobin mobility differences in electrophoresis, 14320
trout,
native-, of Ariz., classification and description of new species, 15629
of upper Kern River basin, Calif., re Salmo, 14235
Sevan, causes of divergence of, 15221
tuna,
bluefin, genic polymorphism of tetrazolium oxidase in, 14242
larval-, particularly Thunnus, 14645
whitefish, round, multiple cistrons for LDH and MDH and achromatic bands, 14885
whitefishes, Lake Sevan-, morphology of, 15223

In vitro,
maturation of catfish oocytes, effect of salmon gonadotropin on, 15217
studies of nifurpirinol (P-7138) against bacterial fish pathogens, 14705
synthesis of protamine in trout-liver cell-free system, 15449
tests of 2 iodophors against bacterial and fungal fish pathogens, 15545

Lake,
Alaw, Wales,
age and growth of trout, 15289
population structure and angling returns, 15355
Arakum lakes, USSR, resorption of gonads of fish re lake discharge, regulation, 14918
Azabach'ye, structural features of young sockeye of, 14388
Baikal,
new data on fauna of Naididae, 15023
primary production from oxidizability of water, 14536
Black-, Canada, limnology and fishery biology of, 15016
Bodensee, effects of exploitation and introductions on salmonid community of, 15338
cage culture of channel catfish, 14676
Canandaigua,
fishes of, 15311
zooplankton and benthos of, 15368
Cayuga, effects of exploitation and introduction on salmonid community of, 15334
central Florida, 5 lakes, food habits of gars in, 14667
Champlain, limnology, 14250
Clear-,
Iowa, reproductive potential of black bullhead in, 15584

Lake, cont.
Clear-, cont.
Texas,
Henneguya texana n. sp. from darter, 14811
Kudoa branchiata sp. n. from spot of, 15323
Elephant Butte-, N. M., re life history of gizzard shad, 14934
Erie,
effects of exploitation, environmental changes and new species on fishery resources, 15345
new parasite records for fish of, 15322
Fennoscandian lakes, future of salmonid communities in, 15348
Folsom, Calif.,
angling quality from roving creel census, 14938
non-reporting of tagged catch by anglers, 14421
Great Central,
effect of fertilization on primary production, 14646
stock of zooplankton after fertilization, 14648
Great Lakes,
concentrations of DDT and dieldrin in fish, 14796
destruction of ecosystem in, and reconstruction possibilities, 15412
heavy metals research in, 1970-71, 14377
Laurentian-, future of salmonid communities in, 15350
region, migrations of adult and juvenile walleyes, 14291
succession factors in oligotrophic fish communities of, 15327
Great Slave, effects of exploitation on salmonid community, 15330
Hidden Valley, Va., trout fishery in, 14352
Huron,
effects of exploitation, eutrophication and introductions on salmonid community, 15343
introduction of kokanee into, 14975
larval lamprey in a bay and tributary, 15418
Iliamna, Alaska, summer food of juvenile sockeye re zooplankton stock, 14988
Issyk-Kul', temperature re spermatozoan speed and fertilizing capacity, 14867
Jacomo, Mo., water quality and surface plankton of, 15105
Keller, characteristics of a culturally unstressed salmonid community, 15128
Kootenay, man's effects on salmonid communities, 15341
La Cloche Mountain lakes, acidification and fish loss, 15615
Ladoga, availability of food and spawning grounds to pikeperch, 15233
Lake of the Woods, Ontario, parasites of fish from, 15146
Leman, effects of exploitation, eutrophication and introductions on salmonid community, 15342
Lewis and Clark, So. Dakota,
age, growth and condition of black crappie, 14579
factors in year-class variation of sauger, 15183
Lockhart Pond, Canada, piscivorous activities of brown bullhead, 15553
Lomond, man's effects on salmonid communities, 15339
Maggiore, effects of exploitation and introductions on salmonid community, 15333
Masurian lakes, Poland, changes in heavy metal content, 15370
McClure, Calif., evaluation of cover retention re angling quality, 15014
Michigan,
effects of dressing and cooking on DDT amount in fishes of, 15256
effects of exploitation, eutrophication and introductions on salmonid community, 15344
population of alewife in, 15253
shrimp trawl used in conjunction with electricity, 14956
utilization of alewives by piscivorous fishes, 14730
Mill, Mich., angling after 5-year fishing ban, 15374
Monona, Wis., distribution and behavior of fishes re thermal effluent, 15607
Nacimiento, Calif., abundance and distribution of fingerling bass, 14424
Okeechobee, Fla., vegetational changes re water level stabilization, 14661
Oneida, development of dominant year-class in yellow perch population, 14455

Lake, cont.
Ontario,
association and species of benthic macroinvertebrates, 14753
benthic community metabolism, 14755
biology studies of, bibliography, 15032
chemistry studies of, bibliography, 15031
eastern, life history of American eel, 15258
effects of exploitation, introductions and eutrophication on salmonid community, 15347
physical studies of, bibliography, 15033
production of benthic macroinvertebrates, 14754
Opeongo, effects of exploitation and introductions on salmonid community, 15335
Ouachita, Ark., predation on rainbow trout by bass and pickerel, 14666
Parker, Fla., utilization of tilapia by fishermen, 14333
Pleshcheyevo, USSR, age and growth of northern pike, 14383
Pskov-Chud, USSR,
conditions of pikeperch reproduction, 15210
oligochaete worms of, 15477
reservoir,
Beaver, Ark., food habits of white bass, 14324
Clark Hill, S. C.,
fecundity of bass, striped X bass, white, 15521
life history of bass, striped X bass, white, 14668
Conowingo,
feeding by channel catfish, 14663
seasonal food habits of adult white crappie, 14877
cooling-, stocked with herbivorous fishes, USSR, 14741
dam-, at Przeczyce, Poland, stocking of Salmo trutta lacustris in, 15386
Dnieper, phenol- and thiocyanate-decomposing bacteria re natural purification of, 14925
Elephant Butte-, primary productivity via ^{14}C method and nutrient analysis in, 15364
Hartwell, S. C.,
fecundity of bass, striped X bass, white, 15521
life history of bass, striped X bass, white, 14668
in South Carolina, thermal effect re fish condition, 15092
Kakhovka, USSR, growth of bream and "Chugunova" paradox, 14522
Keystone, Okla.,
benthic community structure from diversity indices, 15236
life history of striped bass, 14672
species of net zooplankton and physicochemical conditions, 14752
status and artificial reproduction of striped bass, 15519
Kiev-, USSR, oogenesis and maturation of blue bream in, 15234
Kremenchug, USSR,
food requirements and energy balance of young carp, 14525
parasites of carp larvae and fry, 15410
ration of northern pike in, 14929
suffocation re "blooming" of water, 14526
Kuibyshev, flow regulation of Volga re fishes in, 14866
large-, commercial cage-culture of fish in, 15274
Meredith, developing in Texas, chemical limnology, 15457
Merle Collins, mortality and survival of bass in, 15464
Montrose, effects of acid mine drainage on water quality, 15373
Oklahoma-,
feeding by flathead catfish in, 14665
food habits of carp in, 14662
Otmuchov Dam-, Poland, growth and fecundity of bream in, 15276
Russell, Ga., comparison of sampling results with total fish population in, 14659
Sinclair, Ga., thermal pollution re temperature and oxygen levels in, 14664

Lake, cont.
reservoir, cont.
Wanapum Dam-, effect on salmon passage over Columbia River Dam, 14653
Wilkes, Texas, effects of thermal effluent on aquatic life, 15504
Sakakawea, No. Dakota, age and growth of,
perch in Little Mo. Arm, 15284
sauger and walleye, 15440
Salton Sea, ovarian cycling in longjaw gobies from, 14813
Sanctuary, Pa., contribution of Leptodora to fish diet, 15239
Sevan, USSR, causes of divergence of Sevan trout, 15221
St. John, La., Sebekia oxycephala in largemouth bass, 14573
St. Louis, length and weight growth of yellow perch in bay, 15255
Superior,
effects of exploitation and introductions on salmonid community, 15332
western-, factors affecting lake herring abundance, 14450
Swiss lakes, effects of exploitation and eutrophication on salmonid communities, 15331
Tegid, Wales, effect of water fluctuations on littoral fauna, 15367
Texoma, early life history of gars, 14756
Tohopekaliga, Fla., hydrophytic changes re lake fluctuation, measured by point transects, 15526
Torch, Mich., feeding behavior of whitefish and herring, 15577
Vättern, effects of exploitation and introductions on salmonid community, 15336
Windermere, effects of exploitation and introductions on salmonid community, 15337
Winnebago, Wis., evaluation of drum removal, 14317
Winnipeg, ecological notes on longnose dace of, 15153
Wyland, Ind., food consumption of bluegill population, 15209
Yellowstone,
Diphyllobothrium cordiceps in, 14304
ultrasonic tracking and tagging studies of homing cutthroat, 14729

Life history,
bass,
Roanoke, in N. C., 14348, 15525
striped,
in Keystone Reservoir, Okla., 14672
X bass, white, in 2 S. C. reservoirs, 14668
young, of inland Fla., 14671
croaker, in 2 Gulf of Mexico nursery areas, 15404
darter, eastern, johnny, in cold tailwater and sewage-polluted water, 14731
Dicentrarchus labrax, in Irish waters, 15479
eel, American, in eastern Lake Ontario, 15258
fallfish, 14452
flounder, winter, in Long Pond, Newfoundland, 14292
killifish, diamond, 14485
lamprey, mountain-, brook-, in Tennessee, 15630
perch,
pile in Yaquina Bay, Ore., 14933
sand, northern Gulf of Mexico, 14641
pike, northern, in 2 Scottish lochs, 14576
polyodontids, 14382
salmon,
coho, of Karluk River system, Alaska, 14649
masu, off western Kamchatka, 14826
shad,
Alabama, in northwestern Fla., 15140
gizzard, re Elephant Butte Lake, N. M., 14934
shiner,
coastal, in N. C. waters, 14453
red, in Skunk River, Iowa, 14580

Life history, cont.
sportfishes in Biloxi Marsh Complex, La., 15027
spot in 2 Gulf of Mexico nursery areas, 15404
sturgeon stocks of Caspian Sea, propagation based on biology, 14914
trout, steelhead, fall-run-, in Klamath River system, 15463
tuna, skipjack, young in Pacific Ocean, 14269

Limnology,
analysis, cluster, of fish in an upper portion of Potomac River, 14456
and fishes of oligotrophic glacial lakes in,
Europe, 15280
North America, 15279
biology studies of Lake Ontario, bibliography, 15032
Black Lake, Canada, plus fishery biology, 15016
chemical,
analyses of drinking water supplies, Wis., 15126
of developing reservoir in Texas, 15457
chemistry studies of Lake Ontario, bibliography, 15031
classification, chemical-, of waters, 14380
community metabolism in Bay of Quinte and Lake Ontario, 14755
effects of heated waste waters on some microorganisms, 14773
eutrophic,
alkaline waters of Nebraska, survey of fishes in, 14769
reservoir, continuous system models of oxygen depletion in, 14751
eutrophication,
detection and extent of, 15026
of,
experimental lake by addition of nitrate and phosphate, Canada, 14762
Lac Leman, effects on salmonid community, 15342
Lake Erie, effects on fishery resources, 15345
Lake Huron, effects on salmonid community, 15343
Lake Michigan, effects on salmonid community, 15344
Lake Ontario, effects on salmonid community, 15347
Swiss lakes, effects on salmonid communities, 15331
re future of salmonid communities in European subalpine lakes, 15346
the problem, 15281
Great Lakes, succession factors in oligotrophic fish communities of, 15327
hardness of natural waters, 14379
heavy metal ions from lake waters, method of concentrating traces of, 15135
hydrobiological description of trout ponds in western Ukraine, 14530
hydrophytic changes re lake fluctuation, measured by point transects, 15526
impoundment effects on water quality as reflected in parasitism of basses, 14277
inventory and classification of streams in Licking River Drainage, Ky., 14286
lake renewal; correction techniques, demonstration methods, successes and failures, 15024
lakes of Manitoulin Island, Canada, 14977
limnologists, fishery-, world list of, 14628
macroinvertebrates, Bay of Quinte and Lake Ontario, 14753, 14754
macrophytes,
distribution, production and role in S. Mich. marl lake, 14464
factors of photosynthesis and organic-matter excretion in hard-water lakes, 14548
mercuric sulfide, mobilization from sediment into fish under aerobic conditions, 14766
meromixis, development in 2 small Mich. lakes, 15287
metals, heavy-, changes in content in Masurian lakes, Poland, 15370
microbial communities of fresh water, structure and function of, 14491
microorganisms growing on peled spawn, 14776
morphometry of Shield lakes in Saskatchewan, 15392

Limnology, cont.
nutrient,
composition of freshwater lake ecosystem, 15134
parameters in water via algal assay method, 15083
of,
Lake Champlain, 14250
pond receiving animal wastes, 14232
5 Precambrian lakes of Saskatchewan, 15365
sockeye nursery lakes of world, 15326
oligotrophic lakes,
effects of,
eutrophication on salmonid communities in, 15353
exploitation on salmonid communities in, 15351
species introductions on salmonid communities in, 15352
of North America, future of salmonid communities in, 15349
salmonid communities in, introduction to symposium on, 15283
organic matter budget of a Texas reservoir, 14960
physical studies of Lake Ontario, bibliography, 15033
plankton, net-, seasonal cycles in cold-tailwater and natural stream, Ark., 14685
primary,
production,
dependence on physical and chemical factors in small eutrophic lake, 15133
from oxidizability of water of Lake Baikal, 14536
productivity via ^{14}C method and nutrient analysis in, Elephant Butte Res., 15364
re Cs-137 uptake by fish, 14698
recently glaciated lakes, systematics of salmonids of, 15282
reservoirs, fatty alcohols used to reduce surface evaporation, effects on organisms, 14777
SCOL lakes, Canada, review of management approach to, 15324
sediment in Mich. trout stream: source, movement and effects, 14589
species of zooplankton and physiochemical conditions in Keystone Res., Okla., 14752
turbidity measurement, 14449
water,
covering with fatty alcohols, re temperature in carp ponds, 15007
quality,
and surface plankton of Lake Jacomo, Mo., 15105
in Montrose Reservoir, effects of acid mine drainage on, 15373
zooplankton of ponds of Uytash Fish Hatchery, USSR, 14531

Management,
action report, conservation and enhancement of fish and wildlife in national water resources program, 14909
amur, white, for control of aquatic weeds, 15065
angling after a 5-yr fishing ban in Mich. lake, 15374
Annual Report 1971-72 of The Inland Fisheries Trust, Inc., Ireland, 15163
approach to exploitation and introduction in SCOL lakes, Canada, review, 15324
Bureau of Commercial Fisheries Report for 1969, 14614
chub, mojave, introductions for reestablishment, 14418
collection of salmonids at turbine intake of dam, 15199
concentration indices, use in fisheries, 14994
Conservation Directory, 1972, 15303
counter, simple-, electronic-, smolt-, 15205
cover retention re angling quality, evaluation in Calif. lake, 15014
creel,
and use history, 16-yr-, of Noontootla Creek under changing regulations, 14687
census, roving-, to determine angling quality at Folsom Lake, Calif., 14938
drum removal from Lake Winnebago, Wis., evaluation of, 14317

Management, cont.
eutrophication; the problem, detection and extent of, 15026
FAO Aquaculture Bulletin, 15420
fish resources of South Coast Basin, Ore., and water requirements, 15549
fishery,
biology and limnology of Black Lake, Canada, 15016
systems review of, 14395
use of,
anhydrous ammonia, 14347
nursery pond as tool, 14349
fishing effort, exposition on definition of, 15488
fluctuation, water-, detrimental influence on trout streams, 14341
Great Lakes, Laurentian-, future of salmonid communities in, 15350
guide to 28 public fishing lakes of Kentucky, 15533
herbivorous fish used for amelioration in Europe, 15017
inland fisheries and aquaculture, 15277
IPSFC Annual Report for 1971, 15372
lake renewal; correction techniques, demonstration methods, successes and failures, 15024
lamprey, sea, downstream migration before and after use of lampricide in stream, 15627
non-reporting of tagged,
catch by anglers at Folsom Lake, Calif., 14421
largemouth bass, Calif., 14943
Okla. State Lake Creel Survey re improvement of creel survey design, 14679
pond-, potentials of sunfish hybrid in, 15099
questionnaire for assessing angling potential of brown trout waters, 15242
rehabilitation of Atlantic salmon in East River, Sheet Harbor, N. S., 15601
review of fisheries work re Vol. 99 of Trans. Amer. Fish. Soc., 14357
salmon,
landlocked, development of sport fishery for,in reclaimed pond in Maine, 15555
optimal, a model for, 14993
species introductions, effects on salmonid communities in oligotrophic lakes, 15352
sport fishery,
aspects of planning, evaluation and decision making in, 15340
research, BSF&W, 1970, 15329
study tour of North American fisheries by New Zealand group, 14285
sturgeon,
re Volga water diversion, 15227
spiny, changes and role in improvement of Aral Sea, 14389
stocks of Caspian Sea, propagation based on biology, 14914
submerged environment of Fla., its future re dredging, filling, public trust, 14674
sunfish control, improved methods of treating ponds with antimycin A, 14673
survey,
of public fishing in delta regions of east Ark., 14338
procedure for evaluating trout stream fisheries, 14657
threatened freshwater fishes of the U. S., 15172
transplantations of fishes and invertebrates in USSR in 1967, 14394
trap nets, Wisconsin-type-, 10-ft, relationship between lifts and catch of, 14678
trout,
brown, biology re commercial size in Karelian lakes, 14912
in Carpathian mountains, artificial rapids for creation of food supply, 14930
in Hidden Valley Lake, Va., 14352
weed control and herbicides, toxicological effects on fish and other organisms, 14583

Marking,
cold-branding of non-salmonids, 15554
cold-brands, use on channel catfish. 15101
evaluation of several marks on channel catfish, 14656
fluorescent pigments, survival and mark retention of cyprinid, 14724
marks and tags, for marking recently-metamorphosed sea lampreys, 15089
oxytetracycline marks in vertebra, use to determine salmon smolt size, 14227
radiostrontium marking of largemouth bass larvae, 15219
scale size at first annulus as permanent mark of smallmouth bass, 14332
shrimp tagging using internal anchor tags, 15177
tag,
Floy-, anchor-, re growth and survival of brook trout, 15220
loss from juvenile chinook, Ore., algae growth as cause, 14242
readily-recognizable-, for marking European bream, 14260
simple-, fish-, for long-term marking experiments, 15157
small-, sonic-, for measuring fish locomotor behavior, 14784
tags,
dart,
effects on yellow perch, 15194
rates of shedding from yellowfin tuna, 15452
evaluation for northern pike, 15252
ferromagnetic-, internal-, electronic detection for recovery from menhaden, 14957
internal, suitability for Atlantic menhaden, 14995

Mathematics,
analysis, cluster, of fish in an upper portion of Potomac River, 14456
biostatistical method of population analysis, Derzhavin's-, 14612
calculation of specific heat of fish, 14538
capture-recapture experiments for estimation of abundance of fish populations, 14551
computer simulation of effects of mortality on fathead minnow populations, 14287
curves, recruitment-, comparison of two, 14537
estimation of,
natural- and fishing mortality from tag recaptures, 15594
parameters of large fish populations by capture-recapture experiments, 14568
feeding frequency for a maximum daily ration, re 6 fishes, 14836
fish species diversity re stream order and conditions, Plum Creek basin, 15396
formula for calculation of food consumption of fish larvae re zooplankton concentration, 14528
formulae for determining water requirements of salmonids, 14369
likelihood analysis of 3-way contingency tables, 15264
metabolism, community-, in Bay of Quinte and Lake Ontario, 14755
model,
for optimal salmon management, 14993
growth for fishes, and estimation of optimum age of populations, 14510
of,
cycling of elements in estuaries, 15496
fish echo integrator, expression for variance of fish abundance estimates, 14499
selective feeding of aquatic organisms, 14928
vertical distribution and production of phytoplankton, 14924
modelling,
effect of food base on fish population dynamics, 14430
of,
commercial fish population with calculation of variable growth, 14425
interaction between fishery and ecosystem of a body of water, 14864
population of chum salmon of South Kuril' Islands, 15224

Mathematics, cont.
models,
cod-population-, re simulation of changes in abundance, and distribution of fishing, 15567
continuous-system-, of oxygen depletion in eutrophic reservoir, 14751
polluted-stream-, determination of BOD and parameters from DO, 14968
simple-, fishery-, advantages and limitations of, 14301
prediction of phozalon residue dynamics in waters, 15136
production of benthos in Bay of Quinte and Lake Ontario, 14754
relation between production and biomass, 14604
relationship between lifts and catch of 10-ft, Wisconsin-type, trap nets, 14678
relationships between wet weight condition factor and N energy content in sole, 15124
simulation studies of Adams River sockeye, 14599
standard error of LC_{50} and sample size in fish bioassays, 14880
Von Bertalanffy growth curve, application to capture-recapture data, 15291

Migration and movement,
alewives thru fishway, lactic acid in blood during passage, 14302
bass, striped,
population of Sacramento-San Joaquin estuary, 1965-67, 14423
sonic tracking in Chesapeake and Delaware Canal, 15580
carp, grass, tolerance to seawater, 14746
coastal-, of,
Atlantic menhaden, from changes in age and length distributions, 14451
shad off Oregon, 14247
fish movement patterns, use in monitoring zinc in water, 15244
fish movements from Okefenokee Swamp into Suwanee River, 14684
flounder parasites as biological tags, 14781
herring, retention of larvae within Sheepscot Estuary, Me., 14984
homing,
and evidence for home site of yellowtail rockfish, 15425
cutthroat in Yellowstone Lake, ultrasonic tracking and tagging studies of, 14729
of transplanted coho salmon, 14366
in a stream ecosystem, 14251
lamprey,
river, effects of gonadectomy on osmoregulation during, 14809
sea, downstream, before and after use of lampricide in stream, 15627
locomotion detector, inductive-, for diurnal activity studies in fish, 15123
locomotor patterns of pumpkinseed re illumination level, 15293
marlin, blue, and white in Atlantic, 14983
menhaden, Atlantic, and population structure, 15446
of S. Florida marine fishes, 14937
salmon,
Atlantic, changes in cell morphology and hydroxycorticosteroids during freshwater spawning journey, 15149
chum, fatty acid changes during, and early marine growth, 15272
masu, off western Kamchatka, 14826
Pacific, effect of reservoir on passage over Columbia River dam, 14653
pink, identification of even- and odd-yr runs from scales, 15147
quinnat, runs in New Zealand River, 1969-71, 15388
sockeye,
fry in lower Babine River, 15078
immature, in No. Pacific offshore waters, 1956-67, 14633
in coastal British Columbia via ultrasonic tracking, 15427
prolactin and growth hormones in serum and pituitary of, 15148
salmonid migration data, plus sport fishing harvest, Klamath River, 15069
salmonids, collection at turbine intake of dam, 15199
seaward-, of juvenile chinook, temperature and timing of, central Columbia River, 14278

Migration and movement, cont.
semi-migratory fishes of Don River, USSR, factors affecting abundance, 14911
shad, American,
in St. John's River, Fla., 14947
re water temperature, 15487
weight loss during freshwater spawning trip, 15596
shrimps over weirs in La. marshes, 15535
sturgeon,
stellate, during spawning and afterward, in lower Volga River, 14392
tagged in Sacramento-San Joaquin Estuary, 14939
sucker, white, fry down brown-water stream, Canada, 15434
surges of winter flounder into intertidal zone, 14757
swimming ability of fed and starved larval largemouth bass, 14786
trout,
rainbow, introduced-, role of social behavior in dispersal of, 14240
steelhead, temperature effects on, indicated by gill ATPase activities, 15050
walleye, juvenile and adult, in portion of Great Lakes, 14291

Oceanography,
migration and distribution of white- and blue marlin in Atlantic, 14983

Parasites,
Anchoradiscus triangularis, rediscription, from bluegill, 15057
Anisakis simplex, abundance as aid in differentiating American and European Atlantic salmon, 15075
Apophallus brevis,
cyst position, structure and composition; hosts; distribution and variation, 15378
of yellow perch, redescription and resolution of conflict, 14948
Argulus,
alosae, on dying menhaden in Connecticut River, 15598
diversus, black bullhead as new host for, 15406
Basidiobolus ranarum, fungus, distribution in fish, amphibians and reptiles, 14486
Bomocholidae, 4-, from fishes of British Columbia, 14603
Bothriocephalus, use of phenasal against, in carp, 15438
Bunodera
luciopercae, life cycle, 14570
sacculata, life cycle, 14570
Ceratomyxa shasta, control by treating hatchery water supplies, 14703
Cestoda of Coregonus in Sweden, 15156
Clinostomum marginatum, yellow grub in Mo. centrarchids, 15103
Contracaecum osculatur-baicalensis, in northern pike of Caspian Sea, 15315
copepods of some North Carolina fishes, 15061
Crepidostomum sp., in trout of Polish lakes, 15321
dactylogyrids from Nocomis, reciprocus species group, 14469
Diphyllobothrium,
cordiceps in Yellowstone Lake, Wyoming, 14304
spp., occurrence in Alaska, 14629
Diplostomum gasterostei, effects on stickleback populations, 14472
Echinorhynchus clavula, effects on stickleback populations, 14472
Epistylis, cause of "red-sore" disease of fish in SE U. S., 15515
Ergasilus rhinos sp. n. from nasal fossae of 3 centrarchids in N. C., 15399
Eubothrium crassum, abundance as aid in differentiating American and European Atlantic salmon, 15075
fish-,
from Lake of the Woods, Ontario, 15146
in Israel, new records and further data on, 14319
flounder-, as biological tags, 14781
Goezia sp., fish mortalities from, in Fla., 15516

Parasites, cont.
Gyrodactylus,
from Bay of Quinte area, Ontario, 14477
hargisi, from sheepshead minnow, 15243
mobilensis, from sheepshead minnow, 15243
prolongis, redescription from original host, 15243
use of malachine green against, in carp, 15437
Haematozoa,
from marine fish of Newfoundland waters, 15269
in the Atlantic salmon, 15316
helminth-,
in Pacific killifish from S. Calif., 15411
in some fishes of eastern Texas, 14790
of bigmouth buffalo in North Dakota, 15398
of some fishes of Ottawa NWR, Ohio, 15237
population biology of, re minnow in England, 15208
Henneguya,
gambusi sp. n. in mosquitofish, 14470
texana n. sp. from black drum, Clear Lake, Texas, 14811
Icelanonchohaptor gen. n., 15398
Ichthyophonus intestinalis, in trout of Pólish lakes, 15321
Ichthyophthirius,
and other protozoans, control with malachite green-formalin mixtures, 14706
multifilis,
infection of Ugandan fish, 15562
review of control methods, 15563
Kudoa branchiata sp. n. from spot of Clear Lake, Texas, 15323
Lernaeopodidae, structure of attachment organ of, 15426
Myxidium truttae, in trout of Polish lakes, 15321
Myxosoma,
cerebralis,
extraction and study of spores, 14361
morphology of spores of, 14471
pharyngenus sp. n. in mosquitofish, 14470
Nanophyetus salmincola, effect on swimming ability of juvenile salmonids, 14572
Neoechinorhynchus rutili, in trout of Polish lakes, 15321
new records for Lake Erie fish, 15322
of,
carp larvae and fry in upper Kremenchug Reservoir, 15410
cyclostomes and teleosts of Poland, 15139
pike perch in Yaquina Bay, Oregon, 14933
Olencira praegustator, incidence in juvenile menhaden, 15201
parasitism of basses as index of impoundment effects on water quality, 14277
Raphidascaris acus,
in northern pike of Caspian Sea, 15315
in trout of Polish lakes, 15321
Rhabdochona, in fishes of North and Central America, 14606
Salmincola californiensis, influence on reproduction of hatchery rainbow trout, 15187
Sanguinicola davisi, survival and harvest of rainbow trout infected with, 14435
saprolegniosis, data on species composition and ecology of fungal agents, USSR, 14951
Schistocephalus solidus, effects on stickleback populations, 14472
Sebekia oxycephala in bass of Lake St. John, La., 14573
tapeworms, influence on flesh of whitefish and trout, 15275
Triaenophorus crassus, in northern pike of Caspian Sea, 15315
Trichodina, method for microscopical preparations from preserved fish, 14964
trypanosome from the Atlantic cod, 15393
unicellular, control with formalin, 15570
worms of fish, maintenance on synthetic media, 14518

Physical factors,
barometric pressure, effect on spawning of rainbow trout, 15100
Biloxi Marsh Complex, La., re sport fishes in, 15027
buoyancy, negative, compensatory swimming by sockeye in response to, 15204
decompression as cause of immobilization of fingerling salmon and trout, 14958
dependence of primary production on, in small eutrophic lake, 15133
floods, effects on trout in Sagehen Creek, Calif., 15583
flow,
regulation of Volga re reproduction of Kuibyshev Res. fishes, 14866
river-, re distribution and abundance of young striped bass in Calif. estuary, 15579
fluctuation,
pool-, in Corps impoundments, re fish spawning, 14350
water-, detrimental influence on trout streams, 14341
handling and salinity re oxygen requirements of striped bass, 14970
illumination level re locomotor patterns of pumpkinseed, 15293
Keystone Res., Okla., and species of net zooplankton, 14752
Lake Ontario-, bibliography of studies, 15033
light,
activity of Hawaiian reef fishes at dawn and dusk, 15490
and darkness, effect on blood picture of carp, 14997
-dark variation, re daily periodicity of blinded brook trout, 15312
polarized-, perception by yearling sockeye, 14501
magnetic fields, behavior of eel in, 15231
photobarogradient chamber, orientation of young freshwater fishes in, 14874
photoperiod,
effect on gonads of green sunfish in winter, 15176
re growth and food conversion of channel catfish, 14362
regulation of lake discharge, USSR, re resorption of gonads in fishes, 14918
salinity, ionic and body responses to rising salinity in perch, 15414
seismic shock, response of bluegill to, 15115
temperature,
acclimation,
in nervous system of brown bullhead, 14560
re amino acid transport in goldfish gut, 14562
adaptation of fish-brain acetylcholinesterases, 14413
and,
dietary lipids re growth, metabolism and composition of catfish, 14892
migrations of American shad, 15487
photoperiod re development of growth curve for Cladophera glomerata, 15285
swimming speed re oxygen consumption of bass, 14627
changes,
effect of developing striped bass eggs and fry, 14329
re spontaneous activity of skipjack tuna, 15422
dependence of permeability to water and sodium of eel gill epithelium, 15354
differences in heat resistance of sperm of Pacific salmon, 14916
effect on,
bluegill activity, 14543
gonads of green sunfish in winter, 15176
responses of three fishes during hypoxia, 14275
steelhead migration, indicated by gill ATPase activities, 15050
toxicity of zinc to bluegill, 14906
effects on,
branchial sodium exchange and extrusion mechanisms in flounder, 15360
early development of herring, 14602
elevated, chronic effects on fathead minnow, 14444
heterogeneous acclimation of fish to, 15395
high,
acclimation rate of juvenile channel catfish, 14446
lethal-, of golden shiner, 14748
winter-, re emergence of adult aquatic insects, 14378

Physical factors, cont.
temperature, cont.
increased, effects on young estuarine fish, 15532
incubation-, re condition of Atlantic salmon larvae, 14396
influence on rearing of grunion, 15045
low-, threshold for pink salmon eggs re hydroelectric project, 14271
re,
conversion, maintenance and assimilation for walleye, 15621
digestibility of nutrients by carp, 15407
gas secretion by bluegill swimbladder, 14558
growth,
and survival of young brook trout, 15612
food conversion, and body composition of channel catfish, 14733
intermediary metabolism in eels, 14883
osmoregulation in alewife in fresh and sea water, 14440
plasma osmolality and ion level in Atlantic salmon, 15624
rate of food passage thru plaice, 14264
speed and fertilizing capacity of spermatozoa of Issyk-Kul' fishes, 14867
survival of striped bass eggs, larvae, 14420
requirements of salmonids re feeding, bioenergetics, growth, behavior, 15214
rising, respiratory response of Poecilia to, 14561
selection of rainbow trout fingerlings, vertically and horizontally, 14765
tolerance of Pontoporeia affinis under laboratory culture, 15173
water,
in carp ponds, influence of water covering with fatty alcohols, 15007
re fish survival, growth, behavior, 14540
thermal,
acclimation, effect on $NADP^+$-linked IDH in salmonids, 14415
and zinc stress, time until death in bluegill, 14276
maximum, critical-, of juvenile spot, 14255
regime, change as cause of benthos reduction below dam, 15540
stress, effect on predator avoidance in sockeye, 15266
tolerance of juvenile salmonids re N supersaturation, 14408
water,
level fluctuations, effect on littoral fauna of Llyn Tegid, 15367
quality, effect of alteration on white sucker growth, 14336

Physiology,
absorption of nutrients and pH of chyme in carp intestines, 14386
acclimation, heterogeneous-, of fish to temperature, 15395
acetylcholinesterase, fish-brain-,
adaptation to temperature, 14413
characterization with automated pH stat for inhibition studies, 14549
from cutthroat trout, 14447
acid stress in fish, histochemical and cytophotometric assay of, 15572
ACTH cells in pituitaries of freshwater teleosts, histology of, 14848
adenosine 5'-monophosphate, degradation in rainbow trout liver, 14847
adrenal cortical cell morphology and plasma hydroxycorticosteroids, changes during freshwater spawning journey of Atlantic salmon, 15149
alanine aminotransferase in skeletal muscle of carp, 14999
albumin polymorphism in white perch, 14891
aldolase, muscle-, in trout, properties and amino acid composition, 14820
alkaline RNA-hydrolyzing enzyme in pyloric caeca of rainbow trout, 14854
allelic isozyme synthesis, preferential inhibition of, in sunfish hybrid, 14886
alteration in number of oocytes in pink salmon in marine period of life, 15113
amino acids,
-composition and solubilization of fish egg shell membrane, 14636
in mucus of fish skin, 15409
olfactory stimuli in freshwater catfish, 14564
transport in goldfish intestine, effect of temperature, 14562

Physiology, cont.
2-amino-4-phenylthiazole, surveys on anesthetic properties on carp, 15270
anaerobic endproducts of freshwater fish exposed to hypoxia, 14881
anemia, phenylhydrazine-induced-, in chinook salmon, 14780
anoxia and Na loss in death of brook trout at low pH, 14810
antibodies to Aeromonas liquefaciens in fish, detection via fluorescent antibody technique, 15087
antibody,
accumulation in carp re intervals of injection, 15003
and immune response of salmonids to C. columnaris, 14495
formation in carp, effect of low phenol concentrations on, 14428
antigen production in carp for immunization against Aeromonas, 14315
antioxidization systems, effect of salinity on, in non-anadromous fish, 15486
argyrophil adenohypophysial- and other cells in trout demonstrated via new technique, 14635
aspartate aminotransferase isozymes in carp skeletal muscle, 15012
ATPase,
activity in fish homogenates, inhibition by DDT and related compounds, 14552
inhibited by DDT in marine teleosts, 14508
inhibition by organochlorine pesticides in rainbow trout, 14567
auto-antibodies, epithelial-, failure to detect in sera of fish with UDN, 14783
azotic excretion in fish, action of corticoid hormones and ACTH, 14274
biochemical and cytological study of large and dwarf longnose- and white suckers, 14759
bioenergetics of a sand goby population, 15082
blood,
acidity and lactate content in salmon exposed to high p CO_2, 15159
cell lineage in sea lamprey, 14555
characteristics of,
Baikal black grayling re rearing conditions, 15482
grass-, silver- and pond carps, age-related changes, 15483
chemistry and respiration in marine and freshwater eels, 14709
chloride and osmolarity in two stocks of salmon with brief exposure to sea water, 15394
composition of stickleback with adverse oxygen regime, 14915
gas relationships in rainbow trout, 15048
glucose,
changes in Pleuronectes after capture, 15480
effects of starvation and diet on, in carp, 14849
pathway effects on blood-pressure drop in tuna gills, 14233
picture of carp, influence of light and darkness, 14997
proteins from white marlin, genic polymorphism of, 14936
sample preservation for hemoglobin assay, 14711
volume determination in fish, and approach, 14597
body,
compartmentalization and ion distribution in perch, 14808
composition, food conversion and growth of catfish re feeding rates and temperature, 14733
brain AChE inhibition level re death of sheepshead minnows from organophosphates, 15592
branchial sodium exchange and,
ammonia excretion in goldfish, re ammonia loading and temperature, 15362
extrusion mechanisms in flounder, effects of temperature, 15360
buoyancy, negative, effects on bluegill behavior, 15588
cadmium content of fish from 49 bodies of water of New York, 15538
calorie-to-protein ratio for brook trout, 14288
carbohydrases in digestive organs of several fishes, 14841
carbon monoxide, respiratory and circulatory responses of rainbow trout larvae to, 15049

Physiology, cont.
carotenoids,
and vitamin A in rainbow trout eggs, significance in early embryogenesis, 15114
in eggs of sterlet from Danube, 14792
interconversion of algal-to-fish-, in carp, 15010
pigment, amount in herring eggs, 15442
^{14}C-DDT, retention in cellular fractions of resistant and susceptible fish, 15401
chemical composition and body weight of rainbow trout fry in winter, re starvation and rate of artificial feeding, 15249
chloride transport by rainbow trout gills, 14779
chromatin,
patterns in fishes re sexual dimorphism, 14625
trout-, testis-, transformation of, 14467
circulatory and ventilatory responses of rainbow trout to gill surface area change, 14609
CO_2 production and respiratory quotient in tilapia, measurement, 14504
cobalamin synthesis by bacteria of digestive organs of Black Sea fishes, 14527
compensatory swimming by sockeye in response to negative buoyancy, 15204
conditioned-reflex activity of guppies, effect of phenol on, 14515
conversion, maintenance and assimilation for walleye, re size, diet and temperature, 15621
corpuscles of Stannius, failure to observe metabolite changes after removal from eel, 15546
2,4-D ester, dynamics in organs of 3 fishes, 15064
DDT,
degradation by goldfish, 14550
in 8 California marine fishes, 14815
in young salmon after forest spraying, 14511
intoxication in rainbow trout as affected by dieldrin, 15400
residues in,
lake trout as function of age, 15132
white croakers, 15462
determination of N, S and halogens in organic substances, magnesium silicide for sample decomposition in, 14432
dieldrin, levels in fish from Iowa streams, 15212
diethylstilbestrol in feed, effect on catfish, 15593
digestibility of,
nutrients,
by carp re temperature, 15407
in semi-purified rations by catfish in steel troughs, 15509
sunflower, lupin, rye and food mixture by yearling carp, 14863
digestible and indigestible food fractions, differential movement of, in rainbow trout, 14768
digestion,
and ration size in largemouth bass, 14805
rate of larval largemouth bass, 14607
electric sense of sharks and rays, 14487
electrocardiography of eel via underwater electrode, 14832
electrophoresis,
as aid in differentiating American and European Atlantic salmon, 15075
starch-gel-, amine-citrate buffers for pH control in, 15619
electrophoretic investigation of Scorpaenidae, 14987
elemental composition of largemouth bass, 15595
endocrine response of teleosts to restricted environment, 14409
enzyme (LDH and GOT) activity in white sucker blood plasma re metal cations, et al, 14640
enzymes,
energy-metabolism, effects of PCP on, in eel liver, 15059
MFO-, re aldrin epoxidation and parathion activation in fishes, 14898
proteolytic-, in salmon caeca, behavior in gel chromatography, 14823

Physiology, cont.
epiphysis cerebri of fish, slow potential from, 14844
erythrocytes, rainbow-trout-, distribution curve of, 15060
erythropoiesis thru clone cell formation in peripheral blood of white sucker, 14626
essential fatty acids in diet of rainbow trout,
deficiency symptoms, 15117
growth, feed conversion in deficiency symptoms, 15120
re lipid metabolism and fatty acid composition, 15118
esterases,
inheritances in carps and their hybrids, 15356
tissue-, of crappies, comparison by electrophoresis and inhibitors, 14799
exercise and handling, re body weight of fish, 15084
eyes of seatrout, tapeta lucida in, 15062
fatty acid changes in migration and early marine growth of chum salmon, 15272
fatty acids,
dietary-, effect on tissue fatty acids of plaice, 15044
of channel catfish, 15041
FDP, liver-, comparison between trout and rattail, 14480
fecundity of,
largemouth bass receiving artificial food, 14681
yellow perch in Patuxent River, Md., 14545
fishes, re biochemical systematics, 15162
flicker-ERG in rainbow trout, funa and eel, 14857
folic acid production by intestinal bacteria of carp, 15011
food requirements and energy balance of young carp in Kremenchug Res., 14525
forebrain activation of single units in pre-optic area of sunfish, 14557
formalin-treatment stress in salmonids, 14978
gas,
exchange in tuna, some aspects of, 15361
secretion by swimbladder of bluegill re temperature, 14558
gastric evacuation rate in rainbow trout on 3 diets, 15560
gill,
ATP,
activities, indicate temperature effects in steelhead migration, 15050
activity, changes re parr-smolt transformation in salmonids, 15080
eel, localization of 4-^{14}C cortisol in, 15298
epithelium of eel, temperature dependence of permeability to water and sodium, 15354
fish-, relationship between gas and ion transfer across, 15058
mechanisms of salt transfer in fresh and sea water, 14509
vascularization, infra-red photo technique for studying, 15039
ventilation in plaice, assessment of energy cost, 14563
glucose, oral-, intolerance in fish, re study of carbohydrate metabolism, 15211
glucose-6-^{14}C metabolism in carp, effect of diet on, 14850
glycogen,
dynamics in early embryogenesis of goldfish, 14523
phosphorylase activity changes in muscle of pike and sucker after death, 14503
gonad,
maturation of brook trout in high lake with modified photoperiod, 15616
resorption in fishes re regulation of lake discharge, USSR, 14918
gonads, of green sunfish, effects of photoperiod and temperature on, in winter, 15176
gut,
northern pike-, histology of, 14263
plaice-, temperature re rate of food passage, 14264
heavy metals in aquatic organisms, radiotracer technique for study of, 14312
hemagglutinogens of killifish, 14300
hematological,
effect of vibriosis in juvenile chinook, 14373
parameters of immature Atlantic salmon, 15559

Physiology, cont.
hematology, fish-, bibliography, 15202
hemoglobin,
adaptation in catostomids in fast and slow water, 15310
carp-, pH dependence of affinity, kinetics and cooperativity of ligand binding to, 15008
mobility differences in electrophoresis, re tilapias, 14320
salmon, evidence for molecular species with 4 polypeptides, 14512
hepatoma, resistance and defense in older rainbow trout, 15070
hepatopancreatic glycogen, effects of starvation and diet on, in carp, 14849
heterosis in a hybrid swarm of sunfish, 15054
histochemical and cytophotometric assay of acid stress in fish, 14908
histone, new, from trout testis, 14466
hormonal control of teleost ovary, 15435
hypersalinity tolerance of Calif. killifish, field measurements of, 15633
hypoxia,
diurnal, effects on electrophoretic protein patterns and other parameters of rock bass, 15586
respiratory and circulatory responses of rainbow trout larvae to, 15049
temperature effects on responses of 3 fishes, 14275
I^{131} accumulation and activity during development of carp and whitefish, 15405
immune macroglobulin from paddlefish, isolation and characterization of, 14468
immunity in fish, some factors of, 14966
immunodiffusion for distinguishing cunner and tautog eggs, 15040
immunology, phagocytosis of bacteria by carp kidney cells, 15004
inflammatory response of rainbow trout, 14267
inosine 51-monophosphate, degradation in skeletal muscle of marine fishes, 14290
intestine, bluefish-, aerobic microflora of, 15150
iodide, seasonal changes in extra-thyroidal distribution in burbot, 14801
ionic,
and body responses to rising salinity in perch, 15414
patterns in the teleost, 15415
regulation in teleosts, new gill preparation for study of, 15413
isoenzymes of creatine kinase, patterns in teleosts, 15359
isozyme analysis of green sunfish X largemouth bass hybrid, 15052
lactic acid in blood of alewives during fishway passage, 14302
lateral-line,
sense organs, fine structure of, in dogfish, 14879
system of fishes, nervous connections between neuromasts of, 14616
LDH,
allozymes, geographic distribution and enzymatic properties of, in fathead minnow, 15267
isozymes,
cytochrome oxidase activity and muscle ions of rattail, 14481
nervous-system-specific, evolution in fish, 14952
lens iso-precipitin in yellowfin tuna, 15416
lipid,
composition in horsemackerel re maturation of gonads and spawning, 15226
content,
and fatty acid composition of masu salmon at smolt change re light, 14828
effect of starvation and diet on, in carp, 14849
of plasma, liver and viscera in mature and immature female trout, 14840
lipids,
conjugated-, of red salmon kidney, 14829
determination in fishes by Soxhlet and Folch methods, 14391
dietary-, effects on growth, conversion, lipid and fatty acid composition of catfish, 15116
organ-, properties of, in carp with swimbladder disease, 15235
liver,
arginase activity in sockeye salmon, 14569
morphology and enzyme histochemistry of, in bass, 15257

Physiology, cont.
locomotion, fish-, large-amplitude elongated body, theory of, 14878
locomotor restraint and anesthesia, effects on reactions of salmon to pH and CO_2 changes, 15160
lymph system of plaice and other teleosts, 14475
lysolecithin, solubilizing effect on extractability of trout tissues, 14971
lysosomal triglyceride lipase from lateral-line tissue of rainbow trout, 14239
lysosomes, thermally-acclimated-, muscle-,
distribution and particle properties of, in rainbow trout, 15055
zonal centrifugation studies of, in rainbow trout, 15056
malathion, effects on estuarine biota, 15455
maturation,
and fecundity of Salvelinus alpinus on Sakhalin Island, 15228
of catfish oocytes, effect of salmon gonadotropin on, 15217
maturity and fecundity of white seaperch of Tomales Bay, Calif., 14244
MDH loci, homologous-, linkage relationships between, in teleosts, 14953
mechanism, possible-, of insecticide resistance in mosquitofish, 14533
melatonin, locomotor response to, in juvenile sockeye, 14630
mercuric,
ion, rapid uptake by goldfish, 14577
sulfide, mobilization from sediment into fish under aerobic conditions, 14766
mercury,
content in Myoxocephalus in Finland, 14818
determination,
in fish by atomic absorption, interference of fats in, 15250
of traces by atomic absorption spectrometry, 14719
rapid-, in fish, 14618
semi-automated-, in fish tissue, 14590
in fish and birds near polluting industries in Canada, 14593
levels in fish from Wisconsin waters, 14585
mobilization from sediments into guppies, 15428
organic-, determination in fish by emission spectrometry, 14620
metabolism,
carbohydrate-, effects of stress on, in Notopterus, 14265
composition and growth of catfish re temperature and dietary lipids, 14892
dynamics in overwintering carp, 15230
in a stream ecosystem, 14251
intermediary, in eels, effects of temperature and feeding on, 14883
oxygen-consumption and growth of Atlantic cod, 15290
phenyl alanine-, altered by dietary dieldrin, 15450
radiothyroxine-, in several freshwater teleosts, 15379
white-muscle-, in shallow-water marine fishes, 15063
metamorphosis of sea lamprey, timing of changes in blood, morphology and behavior, 15537
methemoglobin in erythrocytes of rainbow trout, 14559
methylmercury in freshwater and marine fishes of eastern Canada, 14498
microelements in carp, effect of low concentrations of phenol on change in amount of, 15441
microhematocrit values re hemoglobin levels and erythrocytes in carp, brook trout, 14788
midgut of Salmonidae, comparative histology of, 14919
monolayer cell culture of bream kidney tissue, 15093
MS-222,
effect on blood sugar and liver glycogen in rainbow trout, 14771
levels in trout blood in anesthesia, branchial irrigation and recovery, 15542
mucus from skin of Black Sea fishes, chemical composition of, 14521
multiple cistrons for LDH and MDH and achromatic bands in round whitefish, 14885
muscle,
catheptic activity of some marine species, 15036
field technique for sampling from living fish, 14298
white-, cardiac-, and red-, proteinic criteria of differentiation of, carp, 14998

Physiology, cont.
myogen comparison of johnny and tessellated darters, and hybrids, 15620
nerve, lateral-line-, in trout, recording electrical activity of, 14715
nervous system of brown bullhead, temperature acclimation in, 14560
nifurpirinol, residues in salmonids, 15301
nitrogen excretion by,
anchovy and jack mackerel, 14990
bluegill, effect of MS-222 on, 14280
nitrogenous metabolites of fish eggs and larvae, 14872
nuclear eye-lens protein variations in sub-populations of Hawaiian striped mullet, 14794
nucleotides, port-mortem degradation of, in trout liver, 14842
nutrition of fishes under intensive production, 14316
olfaction in parent stream selection by alewife, 14542
olfactory,
bulb, electrical responses of, in Pacific salmon, 15543
function of Atlantic salmon, effect of synthetic surfactants on, 14896
oocytes, variations in numbers in marine chum salmon, 15229
oogenesis and maturation of blue bream in Kiev Reservoir, 15234
optic system of some marine fishes, study of, 15484
osmoregulation, effects of gonadectomy on, in migrating river lamprey, 14809
osmoregulatory overcompensation in goldfish nearing freezing, 14553
osmotic and ionic regulation in green sturgeon, 15357
ovarian cycling in longjaw gobies from Salton Sea, 14813
ovaries, quantitative assessment to characterize state of, 14393
oxidases, blood-, alteration in carp with red-spot disease, 15485
oxidative metabolism of rotenone re selective toxicity, 14279
oxygen,
consumption of,
aholehole re salinity, swimming, feeding, 15035
bass re swimming speed and temperature, 14627
fish eggs, use of rotating closed vessels for determination of, 14873
depletion and CO_2 buildup re photic behavior of walleye, 14500
dissolved, minimum required for normal fish life, 14838
equilibrium of trout hemoglobin, 14694
requirements of,
larvae of blenny, goby, skilletfish, 14890
striped bass re salinity and handling, 14970
PCB's,
and organochlorine pesticide in some freshwater and marine fishes, 14582
effect of long-term exposure on ATPase activity in fathead minnow, 15108
peptidase activity in tissues of yellowtail digestive tract, 15445
peptide, histidine-containing-, in brain of post-embryonic sturgeon and pike-perch, 14529
perception of polarized light by yearling sockeye, 14501
periodicity, daily-, of blinded brook trout, 15312
pesticide residue analysis, dry ice homogenization for fish samples in, 14718
pesticides, chlorinated-, gas chromatography-mass spectrometry of residues in foods, 14622
phenol,
adaptation of guppies to, 14517
intoxication of fish, effect of anticholinesterases on, 15121
phospholipids of fish gills, 15251
phosphorylation sites in protamine biosynthesis of trout, 14778
pituitary, goldfish-, histophysiology and innervation via microscopes, 15358
plasma,
esterases of some marine and anadromous fishes, re biochemical systematics, 15162
osmolality and ion level in Atlantic salmon re salinity, temperature and exercise, 15624
prolactin and growth hormone in serum and pituitary of sockeye, 15148

Physiology, cont.
protamine synthesis in trout-liver cell-free system, 15449
protein efficiency re amount in feed of rainbow trout, 15073
proteinase,
mackerel-,
hydrolysis reaction of Nα-benzoyl-L-arginine-amide catalyzed by, 14859
substrate specificity of, 14851
properties from pyloric caeca of mackerel, 14833
purine content, seasonal change of, in masu salmon skin from parr to smolt, 14846
proteins,
egg-, chromatographic separation and molecular weights in high-density fraction, and presence in salmon plasma, 14974
growth hormone- and prolactin-like-, of blue shark, 15494
quinaldine sulfate, efficacy and residues re striped bass anesthesia, 14680
recovery of shocked common shiner re electric energy, 15597
reflection mechanism in silvery layers of fish, 14513
respiration,
aerial, of young gars, social aspects, 14791
influence of branchial resection on, in carp, 14839
rates of winter flounder, factors affecting, 14980
re DDT uptake in mosquitofish, 14476
re failure of bluegill to habituate to handling, 15261
respiratory,
effect and metabolite levels of 2,4-dinitrophenol in herring embryos, 14795
movements of fish, comparison of methods for measuring, 14884
response of,
Poecilia to rising temperature, 14561
teleosts to restricted environment, 14409
respirometry, continuous-flow-, correction for lag in, 15623
responses of brown bullhead to MS-222, 14708
ribonuclease, purification and properties of, from pink salmon liver, 14800
ribonucleotide reductase in immature salmon testes, 14608
rotatory-flow technique for detecting sublethal poisoning of fish, 14860
sensory factors in positioning of school tuna, 14654
serological methods for identification of Atlantic salmon X brown trout, 15203
serology,
blood serum osmolality of catfish and shiner, effect of zinc and copper on, 14442
electrophoresis of sera from some tilapia hybrids, 15006
glycoprotein constituent levels in Pacific salmon sera, 14294
serum esterases of 4 salmonids, molecular weight homogeneity of, 14566
serotonin, locomotor response to, in juvenile sockeye, 14630
slimes, fish-, fluid friction of, 14691
spawning season of rainbow trout, change thru photoperiod manipulation, 15246
specific heat of fish, calculation of, 14538
sperm, differences of heat resistance of, in salmon, 14916
spermatozoa of Issyk-Kul' fishes, temperature re speed and fertilizing capacity of, 14867
staining, vital-, of carp hard tissues with tetracycline-HCl, calcein and alazarin red S, 15002
starvation,
changes in body composition of bass, 15304
prolonged, response of young sockeye to, 14761
steroid 11β-hydroxylase, specificity of, in rainbow trout testes, 15071
swimbladder morphology and specific gravity of myctophids off Ore., 15617
swimming,
ability of fed and starved larval largemouth bass, 14786
of trout,
cruising thrust and power output, 14488
effect of hypoxia and anemia on, 14490
oxygen consumption and swimming efficiency, 14489

Physiology, cont.
swimming, cont.
speed of juvenile coho, effects of temperature on, 15144
thanite, effects on carp blood chemistry after exposure, 15091
thermal,
acclimation, effect of NADP+-linked IDH in salmonids, 14415
compensation in stomach of brook trout, 14565
thiaminase activity in liver and gut of some freshwater fishes, 14524
thiols of proteins, radiochromatographic assay for, using labeled mercury, 14621
thyroid function and dermal purines in brook trout, 14803
tissues, perch-, extracellular spaces and composition of, 14807
toxic effects of zinc sulfate on rainbow trout gill, 15296
toxicity-metabolism relationship of photoisomers of cyclodiene insecticides in freshwater animals, 15363
toxicological effects of cadmium on mummichog, re different environmental parameters, 15168
transferrin types re external characters of carp, 14535
tritium in fish embryo and larva and radiation effect, 14605
tyrosine aminotransferase, study in developing salmon, 14416
urea excretion by fish re concentration of ambient ammonia, 14882
vertebral damage in bluegills exposed to acutely toxic dose of pesticides, 15184
viability of embryos re respiration of spawn from roach and bream of different ages, 14520
visual pigment,
changes in rainbow trout, 15475
distribution within retina in 2 teleosts, 14473
vitamin requirements,
A, in goldfish diet, 14448
minimum-, for carp, 14834
water exchange in the pike egg, 15047
weight loss of American shad during freshwater spawning trip, 15596
wet weight condition factor re N-energy content in sole, 15124
zinc,
concentration in early development of carp, 14514
localization in carp spawn, embryos, larvae, 14775

Plankton,
algae,
ingested by tilapia, culturing method for identification of, 15531
PCB's and DDT alter species composition in mixed cultures, 14967
algal assay for nutrient parameters in water, 15083
-collector, diver-operated-, 15155
concentration of food organisms re rate of consumption by fish larvae, 14528
copepods,
advances in continuous culture of, 15167
continuous recirculating system for, 15170
marine-, on fish larvae, laboratory studies, 14272
counter, automated-, trials with, 15431
euphausiids, diel changes in vertical distribution along Washington coast, 15461
isopod, marine-, predation on juvenile Pacific salmon, 14270
Leptodora and other, contribution to fish diet in Pa. lake, 15239
microbial communities of fresh water, structure and function of, 14491
net-, seasonal cycles in cold tailwater and natural stream in Ark., 14685
N-fixing potential in 2 farm ponds, 15238
phyto-,
algal "bloom" and trace elements, 14534
and calefaction, 14463
eaten by silver carp in Russian ponds, 14740
effect of NTA on growth and metabolism of, in estuary, 15166
flocculation of algae in pure culture with synthetic polymeric flocculants, 15015

Plankton, cont.
phyto-, cont.
mathematical model of vertical distribution and production of, 14924
production in natural and altered areas, Texas coast, 14407
toxicity of mercury to, 15138
pond-, effects of dursban on, 15472
protozoans, response to detergent enzymes, 14411
surface-, of Lake Jacomo, Mo., 15105
zoo-,
food and feeding studies, USSR, 15215
light for collection and separation, 15581
marine-, of Canada, synopsis, 14311
net-, species and physiochemical conditions in Keystone Res., Okla., 14752
of Canandaigua Lake, 15368
of ponds of Uytash Fish Hatchery, USSR, 14531
re summer food of juvenile sockeye, Iliamna Lake, Alaska, 14988
stock in fertilized Great Central Lake, 14648

Pollution,
acid,
histochemical and cytophotometric assay of stress in fish, 14908
mine drainage, effects,
on Montrose Reservoir water quality, 15373
recovery of stream benthos from, 15295
stress in fish, histochemical and cytophotometric assay of, 15572
acidification of the La Cloche Mountain lakes, and fish losses, 15615
agricultural-, effects on recreational uses of surface waters, 15391
alcohols, fatty, for reduction of evaporation from reservoirs, effects on aquatic organisms, 14777
α-TNT, acute toxicity to bluegills, 15460
aluminum hydroxide complexes, toxicity to rainbow trout re pH, 14443
analysis, cluster-, of fish in an upper portion of Potomac River, re power plant, 14456
animal wastes in pond, observations on limnology of, 14232
Aroclor 1221, major components of, 15265
cadmium,
acute and chronic toxicity to fathead minnow, 15611
effects on mummichog re different environmental parameters, 15168
cage for exposing aquatic animals to bottom sediments, 15104
calefaction and phytoplankton, 14463
cans, disposable-, beverage-, use by fish in San Joaquin Valley, 15600
carbaryl, long-term exposure re survival, growth and reproduction of minnow, 15263
Ce-144 in Colorado trout lakes, 14254
chloramine, toxicity to fathead minnow and amphipod, 14972
chlorinated municipal waste, toxicities to trout and minnow, 15606
chlorine,
activity response of brook trout to, 14996
residuals, toxicity to freshwater fish, 14875
toxicity to brown trout, 14642
copper,
effect on blood serum osmolality of catfish and shiner, 14442
goldfish orientation in response to, 15030
ions, acute toxicity to some Hudson River fishes, 14581
DDE, uptake and distribution by chironomid, 15185
DDT,
accumulation,
and persistence in lotic ecosystem, 14976
from water by golden shiners, 15511
concentrations in Great Lakes fish, 14796

Pollution, cont.
DDT, cont.
effect on,
fertility of northern pike in Netherlands, 15106
salinity selection by mosquitofish, 15188
in 8 California marine fishes, 14815
in young salmon after forest spraying, 14511
inhibition of ATPases in marine teleosts, 14508
residues in lake trout as function of age, 15132
separated from PCB's on silica gel, 14584
sublethal, effects on locomotor behavior of goldfish, 15541
uptake re respiration in mosquitofish, 14476
detection of toxicant effects on predator-prey interaction, 15195
detergent enzymes, response of protozoans to, 14411
detergents in water, bibliography, 15021
dieldrin,
concentrations in Great Lakes fish, 14796
dietary-, phenylalanine metabolism altered by, 15450
levels in fish from Iowa streams, 15212
diesel oil contamination of brown trout, 15128
dimethyl ammonium alkyl hydroxamate, chemistry and toxicity to brook trout, 15111
2,4-dinitrophenol, effect on respiration plus metabolies, in herring embryos, 14795
discharge canal of nuclear power plant, survival of young fish in, 14245
domestic waste water in Poland, use for fish culture, 14307
dursban,
effects on pond plankton and insects, 15472
toxicity to fish and aquatic invertebrates in ponds, 15575
ecosystem destruction in Great Lakes and reconstruction possibilities, 15412
effects of chemicals on aquatic life, 15300
effluents, heated, in Poland, use for fish culture, 14309
eutrophication, the problem, 15281
detection and extent of, 15026
effects on salmonid communities of Lakes, 15331, 15342, 15343, 15344, 15345, 15346, 15347, 15348, 15349, 15353
forensic ichthyological examination, principles for conducting, 15609
heavy metals in aquatic organisms, radiotracer technique for study of, 14312
hexachlorocyclohexane-induced malformations during fish embryogeny, 14434
hydrogen sulfide, effects on fish eggs and fry, 15314
industrial-, design of biological early warning system, 15141
industries, forest-based-, impact on freshwater-dependent fish resources in New Brunswick, 15602
insecticide residues in 2 Mississippi oxbow lakes, 14330
iron hydroxide suspensions, lime-neutralized-, effect on brook trout, 15481
kraft mill effluent re flavor of salmon flesh, 14959
lead, biologic effects in fish, 14575
logging and road construction, effects on No. Calif. streams, 14725
malathion, effect on salinity selection by mosquitofish, 15188
manganese strip-mining, stream damage from, 15507
mercuric,
ion, rapid uptake by goldfish, 14577
sulfide, mobilization from sediment into fish under aerobic conditions, 14766
mercury,
accumulation in food chains, 14861
content in Myoxocephalus in Finland, 14818
crayfish as indicator of, 15436
determination,
in fish by atomic absorption, interference of fats in, 15250
of traces by atomic absorption spectrometry, 14719

Pollution, cont.
mercury, cont.
in fish and birds near polluting industries in Canada, 14593
in water, bibliography, 15022
levels,
in an oligotrophic and a eutrophic lake, 14256
in fish from Wisconsin waters, 14585
mobilization from sediments into guppies, 15428
occurrence and effects in ecosystem, 14900
toxicity to phytoplankton, 15138
metal cations and chemicals re LDH and GOT activity in white sucker blood plasma, 14640
metals, heavy,
changes in content in Masurian lakes, Poland, 15370
research in Great Lakes, 1970-71, 14377
methylmercury in freshwater and marine fishes of eastern Canada, 14498
mortality, effects on fathead minnow populations, computer simulation of, 14287
nickel ions, acute toxicity to some Hudson River fishes, 14581
NTA,
determination in inland waters by gas chromatography, 14241
effect on growth and metabolism of estuarine phytoplankton, 15166
oil and oil dispersant, bioassay procedures for toxicity evaluation, 15165
oil-spill removers, toxicity of, 15569
oils, crude, and dispersants, toxicity to shrimp, 15534
organic, biological evaluation of, in Waimakariri River system, 14358
organochlorine pesticides in some freshwater and marine fishes, 14582
outboard motor exhaust, effect on fish and their environment, 14574
PCB,
biological magnification from water by invertebrates, 15129
in water, bibliography, 15020
PCB's,
and DDT, alteration of species composition in mixed cultures of algae, 14967
chromatography-spectrometry characterization of, plus ^{36}Cl-labeling, 14887
effect of long-term exposure on ATPase activity in fathead minnow, 15108
in some freshwater and marine fishes, 14582
pentachlorophenol, effects on energy-metabolism enzymes in eel liver, 15059
pesticides,
column extraction from fish, fish food, mud, 15110
effect on growth and ^{14}C assimilation in alga, 15299
expanded program for monitoring in fish, 15213
in estuaries, 14586
persistent, environmental contamination by, 15444
residues of 20 Mississippi delta lakes, 14675
vertebral damage in bluegills exposed to acutely toxic doses, 15184
phenol,
adaptation of guppies to, 14517
and thiocyanate-decomposing bacteria re natural purification of Dnieper reservoirs, 14925
effect,
of low concentrations on amount of microelements in carp, 15441
of low concentrations on antibody formation in carp, 14428
on conditioned reflex activity of guppies, 14515
intoxication of fish, effect of anticholinesterases on, 15121
phenylmercuric acetate, effect on hatching frequency of zebrafish eggs, 15109
phosphorus,
halides, effect on fish ontogeny, 15125
yellow, acute toxicity to cod and salmon smolts, 15539
phozalon, prediction of residue dynamics in waters, 15136
PMA, number of eggs and young from zebrafish in water containing, 14639
poisoning, sublethal-, rotatory-flow technique for detection in fish, 14860

Pollution, cont.
poisons, PCB's in estuaries, 14586
"pollutant,
analogues" and unstructured marine food webs, 15499
effect on O_2 use of estuarine fish, via respirometer, 15527
pollutants,
actions on population of aquatic organisms, 14427
of fresh water, correlation of structure vs. activity, 14905
polluted stream models, determination of BOD and parameters from DO, 14968
polyoxyethylene esters and ethers, toxicity to salmon and Gammarus, 15297
radionuclides uptake by I-group plaice in Irish Sea, 14474
recovery of damaged streams, 14359
road salt as a polluting element, 14722
rotenone tolerance in mosquitofish, 15127
Ru-106 in Colorado trout lakes, 14254
salmonid-hatchery wastes, evaluation of, 14720
sewage-polluted water vs. cold tailwater re life history of darter, 14731
South River, Va., ecosystematic study of, 15550
spills, hazardous-material-, response of aquatic communities to, 15451
stress, environmental-, responses of teleosts to, 15458
strontium, radioactive-, sensitivity of certain hydrobionts to, 15130
sugar-beet waste ponds in Poland, use for fish culture, 14308
sulphite liquor, spent-, acute toxicity to Atlantic salmon, 15625
surfactants, synthetic, effect on olfactory function of Atlantic salmon, 14896
temperature,
increased, effects on young estuarine fish, 15532
zinc stress, mortality curves of bluegills under, 15578
thermal,
chronic effects on fathead minnow, 14444
discharge in Maryland, winter sport fishing survey in, 15320
effect on some microorganisms, 14773
effluent,
effects on,
aquatic life in E. Texas reservoir, 15504
fish distribution in Lake Catherine waters, Ark., 15505
gas-bubble disease in 13 fishes in contact with, 15506
in South Carolina reservoir re fish condition, 15092
winter responses of largemouth bass to, 15095
fishkill, 14283
high lethal temperatures of golden shiner, 14748
of Columbia River, threat to smelt, 14591
re,
distribution and behavior of fish in Lake Monona, 15607
feeding of juvenile chinook in Columbia River, 14721
morphology of bream, 14922
temperature and oxygen levels in Lake Sinclair, Georgia, 14664
responses of estuarine fishes to increasing gradients, 15459
thermally influenced lake, growth study of sunfishes in, 14345
toxicity of cadmium to mummichog and other organisms, 14492
toxicological assays with fish, 14592
urea-derivative herbicides, chronic effects on fish and their food, 14932
washing enzymes, effects on fishes and other water organisms, 14954
water-, tissue culture bioassay method for, re mercuric chloride, 15254
zectran, effects on trout and benthos in Idaho creek, 15186
zinc,
and thermal stress, time until death in bluegill, 14276
confirmation of autopsy technique for fish mortality from, 14462
effect on blood serum osmolality of catfish and shiner, 14442
ions, acute toxicity to some Hudson River fishes, 14581
sulfate, toxic effects on rainbow trout gill, 15296
toxicity to bluegill, effects of pH, solubility and temperature, 14906
use of fish movement patterns to monitor in water, 15244

Populations,
alewife biology in Lake Michigan, 15253
analysis, Derzhavin's biostatistical method of, 14612
anchovy, northern, age and length in Calif. fishery, 14946
aquatic, actions of pollutants on, 14427
bass,
largemouth, dynamics re harvest in Alabama pond, 14457
striped,
abundance re river flow in Calif. estuary, 15579
of Sacramento-San Joaquin estuary, migrations, 1965-67, 14423
status in Keystone Reservoir, Okla., 15519
biology of,
helminths of minnow in England, 15208
the estuary, 15037
bluegill,
dynamics re harvest in Alabama pond, 14457
food consumption of, Wyland Lake, Indiana, 15209
buffalofishes in Arizona, variability of, 14749
bullhead, black, age and growth under commercial harvest, 14483
catfish,
channel, dynamics re harvest in Alabama pond, 14457
white, dynamics re harvest in Alabama pond, 14457
char, Arctic, characteristics of 2 populations in Swedish lake, 15161
cod, simulation of changes in abundance and distribution of fishing, 15567
commercial-, modelling with calculation of variable growth, 14425
comparison of sampling results with total fish population in Lake Russell, Georgia, 14659
crappie, black-, age, growth and condition in Lewis and Clark Lake, South Dakota, 14579
cutthroat- and Dolly Varden-, segregation between, 14496
dace, longnose, lake-dwelling-, ecological notes on, 15153
density,
age and growth of barbel and grayling in Ourthe River, 14902
initial-, re territory conquest by brown trout in artificial brook, 14901
differences in the swell shark, 15470
effects of trawling in Discovery Bay, Wash., 15376
fish-,
and fish habitat, effect of sediment on, 15402
and limnology of oligotrophic glacial lakes in,
Europe, 15280
North America, 15279
effects of channelization on, in N. C.'s coastal streams, 15502
estimation of,
abundance by capture-recapture experiments, 14551
optimum age of, plus growth model, 14510
modelling the effect of food base on dynamics of, 14430
fish eggs and larvae of Upper Chesapeake Bay, 15046
fishes,
associated with pelagic sargassum complex, 15366
of Canandaigua Lake, 15311
fishing effort, exposition on definition of, 15488
goby, sand, bioenergetics of, 15082
herring,
Atlantic,
abundance and lengths of larvae along western Gulf of Maine, 14985
discreteness in fisheries of Gulf of St. Lawrence, 14237
lake, in western Lake Superior, factors affecting abundance, 14450
Pacific, 15377
juvenile fish in Kremenchug Res., USSR, suffocation re "blooming" of water, 14526
lamprey, larval-, in a Lake Huron bay and tributary, 15418

Populations, cont.
large-, fish-, estimation of parameters by capture-recapture experiments, 14568
littoral fauna, effect of water level fluctuations on, in Llyn Tegid, 15367
menhaden, Atlantic,
effects of fishing on stock, 15180
population structure and movements, 15446
variations in size and length composition of groupings, 15489
young in White Oak River Estuary, No. Carolina, 14406
Nocomis biguttatus species group, 14643
perch,
European, rate at which it populates lakes, 14917
structure in some ponds of Finland, 14821
white, year class strength in Delaware River near artificial island, 14544
yellow, development of dominant year classes, Oneida Lake, 14455
pike, northern, in 2 Scottish lochs, 14576
pupfish,
desert, 14433
Red River, 15397
recruitment curves, comparison of two, 14537
roach-perch lake, USSR, biomass and abundance in, 15225
salmon,
Atlantic, juvenile, behavioral adjustment of density to available food, 14478
salmonid-,
effects of exploitation, eutrophication or introductions on, in various Lakes, 15330, 15331, 15332, 15333, 15334, 15335, 15336, 15337, 15338, 15339, 15341, 15342, 15343, 15344, 15345, 15346, 15347, 15348, 15349, 15350, 15351, 15342, 15353
of Lough Erne waters, recruitment re UDN, 14787
salmonids of recently glaciated lakes, systematics of, 15282
sauger, factors in year-class variation, So. Dakota lake, 15183
sciaenid stocks of middle Atlantic coast, status of, 15380
simulation studies of Adams River sockeye, 14599
sport fishes in Biloxi Marsh Complex, La., 15027
stream-, fish-, effect of annual rechanneling on, 15169
-structure, of chum salmon of South Kuril' Islands, 15224
sturgeon, white, characteristics in Sacramento-San Joaquin Estuary, Calif., via tagging, 14941
sub-, of Hawaiian striped mullet, variations of nuclear eye-lens proteins and -weights, 14794
sunfish-,
growth in thermally influenced lake, 14345
redear, dynamics re harvest in Alabama pond, 14457
trout,
abundance in Sagehen Creek, Calif., 15582
brook, response to habitat development, Lawrence Creek, Wis., 14306
Pigeon River, Mich., effects of stream improvement on, 15421
-structure in Llyn Alaw, Wales, 15355
tuna,
bluefin, genic polymorphism of tetrazolium oxidase in, 14243
yellowfin, mortality estimates in E. Pacific via tagging, 14632
walleye, unexploited-, dynamics in Canadian lake, 15429

Predation,
avoidance by sockeye, effect of thermal stress on, 15266
bass, largemouth, on rainbow trout in Lake Ouachita, Ark., 14666
bullhead, brown, on fishes in Lockhart Pond, Canada, 15553
copepods, marine-, on fish larvae, laboratory studies, 14272
herring, Pacific, on juvenile chinook in British Columbia estuary, 14982
isopod, marine-, on juvenile Pacific salmon, 14270
mosquitofish-, re alteration of ecosystem, 14869

Predation, cont.
pickerel, chain, on rainbow trout in Lake Ouachita, Ark., 14666
pike, northern, vulnerability of some fishes to, 14234
piscivorous fishes in Lake Michigan, utilization of alewives, 14730
predator-prey interaction, detection of toxicant effects on, 15195
predatory fish production and their food consumption in River Vistula, 14259
sculpin,
slimy, on brown trout, 15094
torrent-, on coho salmon fry, increase on moonlit nights, 14507
sea lions on salmon in Monterey Bay, 14817
size-selective-, among juvenile salmonids in British Columbia inlet, 14600
sturgeon, spiny, on gobies in Aral Sea, 14389
trout,
brook, on Atlantic salmon parr, effects of sumithion and DDT, 15029
rainbow,
effect of experience, 14973
re hunger and density and size of prey, 15622
visual mechanism determining flight distance in zebra danio, 14899
vulnerability of fin-clipped bluegill to bass in tanks, 15599

Production,
anchovy, northern, increase in spawning biomass of, 15493
and escapement of Nushagak sockeye run, 1908-66, 14404
bass, striped, fingerlings at Okla. hatcheries, 14351
benthic macroinvertebrates in Bay of Quinte and Lake Ontario, 14754
biology of the estuary, 15037
biomass and abundance in a roach-perch lake, 15225
cage culture of fish in large reservoir lakes, 15274
Coregonus peled, development of 0+ fry in ponds, 15292
fish-,
biological filters for increase in, 15513
in Arkansas in 1969 vs. other states, 14677
in 2 small streams of North Island of New Zealand, 15382
fish,
culture in,
domestic waste water in Poland, 14307
heated effluents, Poland, 14309
sugar-beet waste ponds, Poland, 14308
eggs and larvae of Upper Chesapeake Bay, 15046
in plastic pools, effects of water hardness on, 14342
in 2 Idaho streams, 14458
fisheries, inland-, and extreme pH values, 14282
fishery,
resource assessment, hydroacoustics for, 14257
resources of Lake Erie, effects of exploitation, eutrophication and introduction on, 15345
herring, lake, in western Lake Superior, factors affecting abundance, 14450
insects, aquatic-, in mountain stream, 15474
macrobenthos in ponds, effects of inorganic fertilizer and organic matter on, 14346
macrophytes, in S. Michigan marl lake, 14464
models, simple-, fishery-, advantages and limitations of, 14301
nutritive quality of food in ecosystems, 15245
perch,
white, year class strength in Delaware River near artificial island, 14544
yellow,
development of dominant year classes, Oneida Lake, 14455
fecundity in Patuxent River, Maryland, 14545
phytoplankton-,
mathematical model of, 14924
natural and altered areas, Texas coast, 14407

Production, cont.
predatory fish in River Vistula, and food consumption, 14259
primary-,
dependence on physical and chemical factors in small eutrophic lake, 15133
effect of fertilization on, in Great Central Lake, 14646
estimate in Pa. trout stream thru diurnal oxygen, 15240
from oxidizability of water, Lake Baikal, 14536
productivity via ^{14}C method and nutrient analysis in Elephant Butte Res., 15345
relation with biomass, 14604
sauger, factors in year-class variation of, 15183
shad, threadfin, 14339
walleye, dynamics of unexploited population in Canadian lake, 15429

Radiobiology,
acoustic conditioning for induced aggregation of pond-reared rainbow trout, 14728
^{14}C,
assimilation and growth in alga, effect of pesticides on, 15299
for determination of food consumption of young silver carp, 14744
-DDT, retention in cellular fractions of resistant and susceptible fish, 15401
method for primary productivity in Elephant Butte Res., 15364
4-^{14}C cortisol, localization in eel gill, 15298
calcium-45, accumulation in coho eggs and fry, re effect of Ca on development, 15573
Ce-144 in Colorado trout lakes, 14254
^{36}Cl-labeling of PCB's, 14887
^{137}Cs,
in Colorado trout lakes, 14254
uptake by fish, effect of limnological factors, 14698
echo integrator, expression for variance of fish abundance estimates, 14499
electronic detection for recovery of internal ferromagnetic tags from menhaden, 14957
emission spectrometry for determination of organic mercury in fish, 14620
gamma-irradiated chinook smolts - sex ratios and delay of gonad development, 15576
glucose-6-^{14}C metabolism in carp, effect of diet on, 14850
^{3}H-thymidine for study of erythropoiesis thru clone cell formation in white sucker blood, 14626
hydroacoustics for fishery resource assessment, 14257
I^{131}, accumulation and activity during development of carp and whitefish, 15405
infrared photo technique for studying gill vessels, 15039
integrated echo voltage re fish density, 14497
measurements, acoustic, of fish target strength; a review, 14402
radiochromatographic assay for thiols of proteins using labeled mercury, 14621
radioecology, terrestrial and freshwater, 15025
radioisotopic method of determing bluegill feeding rates, 14340
radionuclides,
retention by Atlantic croaker, 14588
uptake by I-group plaice in Irish Sea, 14474
radiostrontium, for marking largemouth bass larvae, 15219
radiothyroxine metabolism in several freshwater teleosts, 15379
radiotracer technique for heavy metals study in aquatic organisms, 14312
Ru-106 in Colorado trout lakes, 14254
sonic,
tag, small, for measuring fish locomotor behavior, 14784
tracking of striped bass in Chesapeake and Delaware Canal, 15580
strontium, radioactive-, sensitivity of certain hydrobionts to, 15130
tritium in fish embryo and larva and radiation effect, 14695

Radiobiology, cont.
ultrasonic,
sensors for fish activity studies, 14322
tracking,
and tagging studies of homing cutthroat trout in Yellowstone Lake, 14729
re sockeye movements off British Columbia, 15427
used to observe net avoidance in shad, 14293
UV,
apparatuses for sanitizing salmonid facilities, 15453
for attracting insects to caged bluegill, 14360
rays, sterilization of water with, 15131
^{65}Zn,
and stable Zn, distribution in experimental marine ecosystem, 14764
cycling in a simple food web, 14696

Reproduction,
artificial-,
bluegill, development and growth thru one year, 15067
of striped bass from Keystone Reservoir, Okla., 15519
bass, Roanoke, sexual maturity of, in N. C., 15525
biology of Salmo mykiss of Kamchatka River basin, 14384
breeding habits of 2 subspecies of longnose dace, 14804
catfish, channel locomotor responses of male to pheromone of female, 15182
courtship and territoriality in Olympic mudminnow, 15473
fecundity of,
bass, striped X bass, white in 2 S. C. reservoirs, 15521
largemouth bass receiving artificial food, 14681
rainbow trout exposed to X-rays as eyed embryos, 14295
yellow perch in Patuxent River, Maryland, 14545
fertility of northern pike in Netherlands, effect of DDT on, 15106
fertilization of,
pink salmon eggs by sperm from gonadotropin-injected juveniles, 15028
steelhead trout eggs with cryo-preserved sperm, 14979
fish eggs and larvae of Upper Chesapeake Bay, 15046
fishes of Kuibyshev Reservoir, effect of regulation of Volga flow, 14866
gonad maturation of brook trout in high lake with modified photoperiod, 15616
gonadotropin, salmon-, effect on maturation of catfish oocytes, 15217
hatching frequency of zebrafish eggs, effect of phenylmercuric acetate on, 15109
herring, Pacific, effect of intertidal exposure on egg survival and development, 15614
ide, size and age at maturity, ripening and fecundity, 15158
lamprey, American, brook, pre-spawning characteristics, Big Creek, Canada, 14595
mate selection in pumpkinseed and longear sunfish, 14802
maturation,
and fecundity of Arctic char on Sakhalin Island, 15228
of gonads and spawning re lipid composition in horsemackerel, 15226
of white- and black amur in Amur River basin, 14429
maturity and fecundity of white seaperch, Tomales Bay, Calif., 14244
minnow, fathead, re long-term exposure to carbaryl, 15263
nest-digging behavior of rainbow trout, 14631
omul, Baikal-, survival of eggs in Kichera River re flow, 14870
ovarian cycling in longjaw gobies from Salton Sea, 14813
perch, pile, in Yaquina Bay, Oregon, 14933
pikeperch,
Black Sea, in Dnieper-Bug estuary, 14931
conditions in Pskov-Chud Lake, USSR, 15210
Pontoporeia affinis, in laboratory, 15173
potential of black bullhead in Clear Lake, Iowa, 15584

Reproduction, cont.
propagation of,
Caspian sturgeons based on their biology, 14914
grass- and silver carp via pituitary injection, 14865
shad,
Alabama, in northwestern Florida, 15140
American, in St. John's River, Fla., 14947
spawning,
and rearing of grass carp in Arkansas, 14682
behavior, fecundity and food habits of redbreast sunfish, in N.C., 15524
behavior of,
pink salmon on an artificial redd, 15178
red shiner in Burro Creek, Arizona, 15072
silver redhorse in Flint River, Alabama, 14683
biomass of northern anchovy, increase in biomass of, 15493
grounds, availability to Lake Ladoga pikeperch, 15233
induced, of gilthead, Italy, 14888
northern-pike-, ecological signifioance of vegetation to, 15604
of,
American shad in lower Connecticut River, 15375
largemouth bass under laboratory conditions, 15589
longear sunfish, intraspecific intrusions into nests, 15200
4 species of bass in ponds, 15501
striped mullet at sea, a case for, 15468
rainbow-trout-, effect of barometric pressure on, 15100
re pool fluctuation in Corps impoundments, 14350
season of rainbow trout, change thru photoperiod manipulation, 15246
-site selection by sockeye in small streams, 14992
sounds of red salmon, 14399
sperm, storage and dilution, effects on fertilization of brook trout eggs, 15565
sunfish, green, effects of photoperiod and temperature on gonads in winter, 15176
teleost-, environmental control of, 14789
zebrafish, number of eggs and young produced in water containing PMA, 14639

Research,
acid stress in fish, histochemical and cytophotometric assay of, 14908, 15572
action report, conservation and enhancement of fish and wildlife in national water resources program, 14909
Aeromonas salmonicida, virulence and persistence of forms inoculated into coho, 15085
algal assay for nutrient parameters in water, 15083
anesthetic properties of 2-amino-4-phenylthiazole, surveys on, on carp, 15270
Annual Report 1971/72 of The Inland Fisheries Trust, Inc., Ireland, 15163
antimycin,
A, improved method of treating ponds for sunfish control, 15673
exposure times required to kill carp, sucker, bullhead, 15079
half-life of biological activity via fish bioassay, 14734
Aroclor 1221, major components of, 15265
bioassays,
fish-, standard error of LC_{50} and sample size in, 14880
identical-, variation in results with minnows subjected to instant temperature increase, 15547
intermittent-flow-, metering device for chemicals in, 15603
procedures for oil and oil dispersant toxicity evaluation, 15165
biological early warning system re industrial pollution, 15141
bluegill as experimental animal, development and growth thru one year, 15067
Bureau of Commercial Fisheries Report for 1969, 14614
^{14}C-DDT, retention in cellular fractions of resistant and susceptible fish, 15401
cadmium,
acute and chronic toxicity to fathead minnow, 15611
content of fish from 49 waters of New York, 15538
effects on mummichog re different environmental parameters, 15168

Research, cont.
cage for exposing aquatic animals to bottom sediments, 15104
carp, grass,
sensitivity to fish toxicants, 14707
weed control in India, 14745
channel catfish virus, at Auburn Univ., Alabama, 14797
chemical analyses of drinking water supplies (including trace metals), Wis., 15126
chlorine, activity response of brook trout to, 14996
Cladophera glomerata, development of growth curve re temperature and photoperiod, 15285
Conservation Directory 1972, 15303
2,4-D ester dynamics in organs of three fishes, 15064
DDE, uptake and distribution by chironomid, 15185
DDT,
intoxication in rainbow trout as affected by dieldrin, 15400
separated from PCB's on silica gel, 14584
determination of N, S and halogens in organic substances, magnesium silicide for sample decomposition, 14432
dimethyl ammonium alkyl hydroxamate, chemistry and toxicity to brook trout, 15111
dursban, toxicity to fish and aquatic invertebrates in ponds, 15575
effects of chemicals on aquatic life, 15300
electrophoresis, starch-gel-, amine-citrate buffers for pH control in, 15619
elemental composition of largemouth bass, 15595
eutrophication,
of experimental lake by nitrate and phosphate addition, Canada, 14672
the problem, detection and extent of, 15026
FAO Aquaculture Bulletin, 15271, 15420
fertilization of steelhead trout eggs with cryo-preserved sperm, 14979
fish-,
disease-, 14414
nutrition-, priorities in, 15369
resources of South Coast Basin, Ore., and water requirements, 15549
fisheries development around Virgin Islands, 14356
forensic ichthyological examinations, principles for, 15609
gastric evacuation rate in rainbow trout on 3 diets, 15560
heavy metal ions from lake waters, method of concentrating traces of, 15135
herbivorous fish in USSR, 14742
huratoxin piscicide, isolation and characterization, 14637
lake renewal; correction techniques, demonstration methods, successes and failures, 15024
lamprey, sea, downstream migration before and after use of lampricide in stream, 15627
masoten, determination of metrifonat residue after treating fish for parasitosis, 14889
mercury determination,
in fish by atomic absorption, interference of fats in, 15250
of traces by atomic absorption spectrometry, 14719
organic-, in fish by emission spectrometry, 14620
rapid-, in fish, 14618
semi-automated-, in fish tissue, 14590
metals, heavy in Great Lakes, 1970-71, 14377
methoxychlor; acute toxicity and breakdown studies, 15181
MFO activity in freshwater fishes: aldrin epoxidation and parathion activation, 14898
mortality curves of bluegills under temperature and zinc stress, 15578
MS-222, levels in trout blood in anesthesia, branchial irrigation and recovery, 15542
nifurpirinol, efficacy, toxicity and residues in salmonids, 15301
non-reporting of tagged largemouth bass, Calif., 14943

Research, cont.
organometallic compounds, chemical composition re toxicity for hydrobionts, 15143
PCB, biological magnification from water by invertebrates, 15129
PCB's chromatography-spectrometry characterization of, plus ^{36}Cl-labeling, 14887
pesticide residues, chlorinated-, chromatography-mass spectrometry of, in foods, 14622
pesticides,
column extraction from fish, fish food, mud, 15110
dry ice homogenization for fish samples in residue analysis, 14718
vertebral damage in bluegills exposed to acutely toxic doses, 15184
pH, lethal-, for white sucker, 15191
phenol intoxication of fish, effect of anticholinesterases on, 15121
pheromone of female channel catfish, locomotor responses of male to, 15182
phozalon, prediction of residue dynamics in waters, 15136
pollutants,
actions on population of aquatic organisms, 14427
of fresh water, correlation of structure vs. activity, 14905
quinaldine sulfate, efficacy and residues re striped bass anesthesia, 14680
quinine sulfate, effect on redifferentiation and growth inhibition of eel tumor, 15568
radiochromatographic assay for thiols of proteins using labeled mercury, 14621
resistance of dominant and submissive bluegills to lethal zinc concentration, effect of shelters on, 15544
respirometry, continuous-flow-, correction for lag in, 15623
review of fisheries work in Vol. 99 of Trans. Amer. Fish. Soc., 14357
rotenone,
exposure times required to kill carp, sucker, bullhead, 15079
oxidative metabolism re selective toxicity, 14279
tolerance in mosquitofish, 15127
salicylanilide I, an effective, non-persistent, candidate piscicide, 15591
spawning of largemouth bass under laboratory conditions, 15589
sport fishery-, BSF&W, 1970, 15329
squoxin, tolerance of juvenile sockeye and zooplankton to, 15551
strontium, radioactive-, sensitivity of certain hydrobionts to, 15130
study tour of No. American fisheries by New Zealand group, 14285
tank, environmental-control-, for salmon growth and metabolism study, 14825
temperature requirements of salmonids re feeding, bioenergetics, growth, behavior, 15214
TFM as a lamprey larvicide, literature review of, 14961
thanite, effects on blood chemistry of carp after exposure, 15091
threatened freshwater fishes of the U. S., 15172
tissue culture bioassay method for water pollution, re mercuric chloride, 15254
toxicant effects on predator-prey interaction, detection of, 15195
toxicity, acute,
of organochlorine insecticides to surf perches, 14945
of spent sulphite liquor to Atlantic salmon, 15625
toxicological assays with fish, 14592
trout, rainbow, hatchery-, influence of parasitic copepod on, 15187
tuna, report of FAO panel for facilitation of, 15278
vessels of NMFS, 14368
Zn toxicity to bluegill, effects of pH, solubility and temperature, 14906

River,
Adams, simulation studies of sockeye, 14599
Alabama-, system, upper, new cyprinid from 14321
Amur basin, age growth and maturation of white- and black amurs, 14429
Apalachicola, Fla., biology of Alabama shad in, 15140
Babine, lower-, migration of sockeye fry in, 15078
Bear Valley Creek, Idaho, effects of zectran on trout and benthos in, 15186

River, cont.
Bideford, P.E.I., benthos trapped leaving bottom of, 15626
Cahaba, Alabama, age and growth of river redhorse, 14326
Chesapeake and Delaware Canal, sonic tracking of striped bass in, 15580
Columbia,
central-, temperature, timing and seaward migration of juvenile chinook, 14278
effect of Wanapum Dam Reservoir on salmon passage over Rock Island Dam, 14653
feeding of juvenile chinook re thermal pollution, 14721
scale patterns for identifying races of spring chinook, 14229
thermal pollution of, threat to smelt, 14591
Connecticut,
Argulus alosae on dying menhaden, 15598
lower-, spawning of American shad, 15375
Danube, carotenoids in sterlet eggs from 14792
Delaware, age, growth, abundance and survival of white perch, 14544
Don, factors affecting abundance of semi-migratory fishes, 14911
East, Nova Scotia, rehabilitation of Atlantic salmon in, 15601
Flint, Ala., spawning behavior, age and growth, and sport fishery for silver redhorse, 14683
Hakataramea, New Zealand, runs of quinnat salmon 1969-71, 15388
Karluk-, system, life history of coho salmon, 14649
Kern Basin, Calif., trouts of, re Salmo, 14235
Kichera, survival of Baikal omul eggs re flow, 14870
Klamath,
sport-fishing harvest in section of, plus salmonid migration data, 15069
-system, characteristics of fall-run steelhead, 15463
Lawrence Creek, Wis., responses of brook trout population to habitat development, 14306
Leaf-, Quebec, otoliths for aging round whitefish of, 15218
Licking-, Drainage, Ky., inventory and classification of streams in, 14286
Lookingglass Creek, growth of juvenile spring chinook salmon, 14231
Madison-Firehole, Yellowstone Park, fisherman survey of, 1969, 15190
Mink, Manitoba, ecological segregation between daces, 15536
Moapa, Nev., ecological distribution of fishes of, 15574
Murphy Flowage, Wis., harvest and food habits of bass, 14303
Noontootla Creek, 16-yr creel and use history of trout stream under changing regulations, 14687
Ourthe, population density, age and growth of barbel and grayling in, 14902
Patuxent, Maryland, fecundity of yellow perch, 14545
Pechora, USSR, question of propagation of salmon of, 15454
Pere Marquette, downstream migration of sea lamprey before and after use of lampricide, 15627
Pigeon, Mich., effects of stream improvement on trout harvest and crop, 15421
Pine-Popple, Wis., aquatic insects of, 14962
Plum Creek drainage basin, fish species diversity re stream order and conditions, 15396
Potomac,
cluster analysis of fish in an upper portion, 14456
distribution of juvenile river herring in, 14337
Rangitata, New Zealand, age and growth of chinook salmon, 15286
Rappahannock, Va.,
age composition and magnitude of striped bass winter gill-net catches, 14690
hermaphroditic alewife from 15628
occurrence and growth of hybrid bass, striped X white, 14459
Red, distribution and ecology of Red River pupfish, 15397
Sagehen Creek, Calif., abundance and harvest of trout, 15582
Shasta, 1970 sport harvest, including steelhead, 15051
Skunk-, Iowa, life history of red shiner, 14580
South, Va., ecosystematic study of, 15550

River, cont.
St. John's, Fla., investigations on American shad in, 14947
Stillaguamish, Wash., No. Fork, evaluation of winter steelhead fishery, 14727
Suwanee, fish movements from Okefenokee Swamp into, 14684
Sydenham, Canada, contribution of stocking of brown trout to self-sustaining fishery, 15384
Vistula, production and food consumption of predatory fish in, 14259
Volga,
flow regulation re reproduction of Kuibyshev Reservoir fishes, 14866
lower, spawning and postspawning migrations of stellate sturgeon, 14392
water diversion re sturgeon, 15227
Waimakariri, New Zealand, biological evaluation of organic pollution in, 14358

Sampling,
anchovy larvae with plankton purse seine, 15491
bass, largemouth, fingerlings in Lake Nacimiento, Calif., 14424
bottom,
and surface-, with single otter trawl via removable hydrofoils, 14686
stream-, procedure for using square-foot sampler, 14353
electrofishing,
effects on invertebrates of English stream, 14907
systems, DC-, portable, guideline for, 14398
macroinvertebrates, comparison of 3 methods of handpicking, 15530
muscle of living fish, field technique, 14298
non-report of tagged,
catch by anglers at Folsom Lake, Calif., 14421
largemouth bass, Calif., 14943
phytomacrofauna, aquatic, quantitative sampler for, 14502
postal survey of sport fishery, biased harvest estimates from, 15174
sampler, shallow-water-, core-, 14374
samples, benthic-, sugar flotation and dye for sorting, 14441
shallow-water habitats, trapnet for, 15137
shrimp, postlarval, in Vermilion Bay, La., plus temperature and salinity data, 14412

Specific,
aholehole, 15035
alewife, 14248, 14302, 14337, 14440, 14542, 14730, 15253, 15311, 15327, 15334, 15347, 15350, 15628
amur,
black, 14429
white, 14417, 14429
anchovy, 14272, 14990, 15491
bay, 15318
northern, 14419, 14946, 15492, 15493
asp, 14866
ayu, 14844
bairdiella, 14814
balloonfish, 14767
barbel, 14902
bass, 15212
largemouth, 14277, 14303, 14330, 14343, 14372, 14421, 14424, 14437, 14457, 14573, 14607, 14627, 14666, 14681, 14714, 14786, 14805, 14899, 14938, 14943, 15018, 15095,

Specific, cont.
bass, cont.
largemouth, cont., 15103, 15195, 15219, 15257, 15304, 15464, 15503, 15575, 15589, 15595, 15599
redeye, 15500, 15501
Roanoke, 14348, 15525
rock, 15586
smallmouth, 14277, 14332, 14730, 14938, 15018, 15103, 15311, 15335, 15500, 15501
spotted, 14277, 15500, 15501
striped, 14329, 14351, 14420, 14423, 14581, 14669, 14671, 14672, 14680, 14690, 14970, 15154, 15459, 15516, 15518, 15519, 15520, 15522, 15579, 15580
striped X white, 14459, 14668, 15521
Suwanee, 15500, 15501
white, 14324, 14327
bighead, 14736, 14738, 14871, 15017
bleak, 14866
blenny, striped, 14890
bloater, 15256
bluefish, 14543, 15150, 15459

Specific, cont.
bluegill, 14275, 14276, 14280, 14340, 14343, 14345, 14360, 14421, 14437, 14439, 14457, 14462, 14558, 14704, 14722, 14881, 14906, 14938, 15018, 15057, 15066, 15067, 15092, 15103, 15115, 15171, 15184, 15209, 15212, 15261, 15311, 15363, 15460, 15544, 15575, 15578, 15588, 15599, 15610
bowfin, 14684, 14723, 14730
bream,
blue, 15234
European, 14260, 14520, 14524, 14918, 14922, 15093, 15276,
red, sea, 14835
white, 14866
buffalo, 15212
bigmouth, 14689, 14749, 15398
black, 14749
smallmouth, 14689, 14749
bullhead,
black, 14483, 14769, 15237, 15406, 15584
brown, 14275, 14560, 14708, 14881, 15379, 15553
yellow, 15311
burbot, 14730, 14801, 14966, 15016, 15347, 15379
Carcharhinus leucas, 15294
carp, 14315, 14316, 14386, 14428, 14505, 14514, 14525, 14532. 14596, 14617, 14662, 14696, 14700, 14736, 14737, 14743, 14775, 14788, 14834, 14838, 14839, 14841, 14849, 14850, 14863, 14918, 14921, 14965, 14966, 14997, 14998, 14999, 15000, 15001, 15002, 15003, 15004, 15005, 15007, 15008, 15010, 15011, 15012, 15013, 15079, 15091, 15212, 15230, 15235, 15270, 15347, 15403, 15405, 15407, 15408, 15410, 15437, 15438, 15439, 15441, 15483, 15485, 15608
crucian, 15121, 15125, 15403
grass, 14385, 14682, 14707, 14736, 14737, 14741, 14742, 14743, 14745, 14746, 14865, 14871, 15017, 15065, 15483
silver, 14417, 14596, 14736, 14738, 14740, 14741, 14744, 14865, 14871, 15017, 15483
catfish, 14445, 15212, 15217
blue, 14354, 15512
channel, 14323, 14334, 14344, 14354, 14362, 14363, 14442, 14446, 14457, 14535, 14638, 14656, 14663, 14676, 14688, 14697, 14706, 14733, 14797, 14806, 14812, 14862, 14892, 14893, 15041, 15077, 15097,

Specific, cont.
catfish, cont.
channel, cont., 15101, 15116, 15379, 15509, 15510, 15512, 15514, 15593, 15610
flathead, 14665
white, 14344, 14354, 14421, 14457, 14564, 15512
Catostomus clarkii, 15310
char, Arctic, 15018, 15161, 15228, 15331, 15333, 15336, 15338, 15342
chub, 14889
lake, 15016
Mojave, 14418
cisco, 15016, 15018, 15311, 15330, 15334, 15335, 15347, 15548
Baikal, 15232
cod, 14582, 15290, 15393, 15394, 15539, 15567
Pacific, 15376
Coregonus, 15333
lavaretus,
ludoga, 15223
maraenoides, 15223
macrophthalmus, 15333
peled, 14776, 15292
crappie, 15018, 15212
black, 14437, 14579, 14799, 15053, 15092, 15311, 15356
white, 14799, 14877, 15053, 15103, 15356
croaker, 14325
Atlantic, 14588, 15380, 15404
white, 15462
cunner, 15050
dab, 15307
dace,
blacknose, 14313, 15074, 15536
leopard, 15074
longnose, 14804, 14908, 15074, 15153, 15536, 15572
rosyside, 14894
speckled, 15074, 15529
danio, zebra, 14899
darter,
bluebreast, 15631
harlequin, 14750
johnny, 14731, 15620
orangebelly, 15241
tessellated, 15620
Dicentrarchus labrax, 15305, 15479
Dolly Varden, 14496, 15186, 15259
dragonet, 14473
drum, black, 14811
eel, 14831, 14832, 14838, 14857, 14889, 15059, 15231, 15354, 15382
American, 14498, 14709, 14883, 15018, 15258, 15298, 15546
European, 14904, 15456, 15568
Etheostoma chlorobranchium, 15631
fallfish, 14452

Specific, cont.
flier, 15399
flounder,
broad, 14556
starry, 14494, 15376
winter, 14292, 14508, 14757, 14980, 14981, 15102, 15459
yellowtail, 14508
funa, 14857
Galaxias divergens, 15382
Gambusia,
affinis, 14426
heterochir, 14426
gar, 14756, 14791
alligator, 14723
Florida, 14667
longnose, 14667, 14723
shortnose, 14723
spotted, 14723, 15192
Gillichthys seta, 14767
gilthead, 14888
Gobiosoma paradoxum, 14767
Gobius,
cephalarges, 14274
melanostomum, 14274
goby, 14836
longjaw, 14813
naked, 14890
sand, 15082
goldfish, 14448, 14523, 14550, 14553, 14562, 14577, 14836, 14882, 15018, 15030, 15211, 15237, 15358, 15362, 15379, 15541
grayling, 14902
Arctic, 15016, 15018
Baikal, 15232, 15482
grunion, 15045
guppy, 14515, 14517, 15428
hake,
Pacific, 14497
southern, 15590
spotted, 15590
herring, 15442, 15613
Atlantic, 14237, 14582, 14795, 14984, 14985
blueback, 14337, 14739
lake, 14450, 15344, 15345, 15577, 15615
Pacific, 14497, 14602, 14699, 14982, 15376, 15377, 15614
horsemackerel, Black Sea, 15226
Hybognathus placitus, 15397
Hypobsis lineapunctata, 14321
ide, 15125, 15158
jack,
cottonmouth, 15469
crevalle, 15459
killifish, 14300
banded, 14581
California, 15633
Specific, cont.
killifish, cont.
gulf, 15087, 15243
Pacific, 15411
Rio Grande, 15397
striped, 14785, 15459
king O'Norway, 14508
kingfish, northern, 15459
lamprey,
American, brook, 14595, 15418
mountain, brook, 15630
river, 14809
sea, 14555, 14961, 15089, 15327, 15332, 15334, 15343, 15347, 15350, 15418, 15537, 15627
lanternfish, 15617
Lebistes reticulatus, 14777
Lepomis, 15397
Leuciscus, 14878
lingcod, 14815
mackerel, 14508, 14833, 14851, 14859
jack, 14836, 14990
Pacific, 15497
madtom, tadpole, 15311
marlin,
blue, 14983
striped 14935
white, 14936, 14983
medaka, 14493
menhaden, Atlantic, 14405, 14406, 14451, 14547, 14651, 14995, 15180, 15201, 15446, 15489, 15598
minnow, 15232, 15363
fathead, 14287, 14289, 14444, 14546, 14769, 14875, 14908, 14972, 15087, 15108, 15181, 15263, 15267, 15547, 15572, 15606, 15611
sheepshead, 14732, 15243, 15459, 15592
silverjaw, 14484, 14876
Monodactylus argenteus, 14798
mosquitofish, 14470, 14476, 14533, 14869, 15127, 15188, 15195, 15397, 15401
mudminnow, Olympic, 15473
mullet, 15608
striped, 14794, 15468
mummichog, 14236, 14492, 14785, 15459
muskellunge, 14397, 14465, 15262
Myoxocephalus, 14571
quadricornis, 14818
Nocomis, 14469
biguttatus, 14643
Nothonotus, 15631
Notopterus notopterus, 14265
Notropis pilsbryi X Chrosomus erythrogaster, 14782
Odontastis taurus, 15294
omul, Baikal, 14870

Specific, cont.
paddlefish, 14382, 14468
Chinese, 14382
perch, 14807, 14808, 14821, 15018, 15125
dwarf, 14945
European, 14917, 14929, 15163, 15225, 15232, 15342, 15414, 15415
pile, 14933
Sacramento, 14769
sand, 14641
shiner, 14816, 14945
silver, 15459
white, 14454, 14498, 14544, 14581, 14891, 15320, 15347, 15459
yellow, 14454, 14498, 14545, 14730, 14948, 15171, 15181, 15193, 15194, 15255, 15256, 15284, 15327, 15345, 15347, 15377, 15548
Philypnodon breviceps, 15382
Phoxinus phoxinus, 15208
pickerel, 15262
chain, 14498, 14666, 15196, 15311
pike,
blue, 15345
northern, 14234, 14262, 14263, 14383, 14503, 14576, 14730, 14769, 14929, 15016, 15018, 15047, 15106, 15125, 15163, 15212, 15252, 15262, 15315, 15604
pikeperch,
Black Sea, 14931
European, 14519, 14529, 14913, 14966, 15210, 15233, 15348
Pimephales, 15397
pinfish, 15459
plaice, 14263, 14474, 14475, 14563, 15044, 15206, 15288, 15307, 15480
Platichthys flesus, 14781, 15360
Poecilia reticulata, 14561
porcupinefish, 14767
porgy, red, 15585
puffer, northern, 15459
pumpkinseed, 14802, 15293, 15399, 15553
pupfish,
desert, 14433
Red River, 15112, 15397
Raja clavata, 14487
rattail, 14480, 14481
roughscale, 14815
redhorse,
river, 14326
silver, 14683
Rivulus cylindraceus, 14954

Specific, cont.
roach,
Azov, 14913
European, 14513, 14520, 14524, 14860, 14918, 14929, 14966, 15225, 15232, 15342
rockbass, 15103
rockfish, 14836
coral-red, 15495
yellowtail, 15425
rudd, 14473, 14524
sablefish, 14610, 14815, 15086, 15433
sailfish, 14935
Salmo,
aguabonita,
aguabonita, 14235
gilberti, 14235
apache, 15629
mykiss, 14384
trutta lacustris, 15386
salmon, 14227, 14416, 14608, 14817, 14852, 14919, 14959, 14993, 15119, 15199, 15283, 15324, 15339, 15346, 15348, 15350, 15351, 15352, 15454
Atlantic, 14396, 14478, 14498, 14511, 14566, 14582, 14783, 14895, 14896, 15029, 15075, 15107, 15149, 15151, 15149, 15160, 15203, 15297, 15316, 15337, 15347, 15539, 15559, 15601, 15624, 15625
chinook, 14228, 14229, 14231, 14242, 14278, 14294, 14367, 14373, 14458, 14650, 14653, 14721, 14758, 14780, 14958, 14982, 14991, 15038, 15069, 15080, 15088, 15214, 15286, 15302, 15556, 15576
chum, 14600, 14601, 14634, 14823, 14824, 14827, 14830, 15224, 15229, 15272
coho, 14294, 14366, 14495, 14507, 14572, 14600, 14649, 14958, 14974, 14978, 15018, 15069, 15080, 15085, 15144, 15256, 15266, 15543, 15548, 15556, 15561, 15573
landlocked, 15336, 15555
masu, 14826, 14828, 14846
Pacific, 14270, 14408, 14512, 14916, 15372
pink, 14271, 14387, 14600, 14601, 14800, 14824, 14827, 15028, 15113, 15147, 15178, 15618
quinnat, 14249, 15388
sockeye, 14294, 14322, 14388, 14399, 14404, 14497, 14501, 14569, 14599, 14611, 14630, 14633, 14647, 14652, 14653, 14760, 14761, 14827, 14829, 14944, 14975, 14988, 14992, 15018, 15078, 15148, 15204, 15207, 15266, 15341, 15387, 15427, 15543, 15551, 15556

Specific, cont.
Salvelinus, 15222
willughbii, 15337
sanddab, 14815
sardine,
Pacific, 15498
scaled, 15318
sargo, 14814
sauger, 15183, 15440
scorpionfish, Calif., 15466
sculpin, 14904
longhorned, 14508
reticulate, 15198
slimy, 15094
torrent, 14507, 15198
yellowfin, Baikal, 15232
Scyliorhinus, 14487, 14879
seahorse, spotted, 15459
seaperch,
rubberlip, 14816
sharpnose, 14816
white, 14244
seatrout, 15062
Sebastes rufinanus, 15632
shad, 14247
Alabama, 15140
American, 14293, 14947, 15375, 15487, 15596
gizzard, 14934
threadfin, 14339
shark,
blue, 15163, 15494
porbeagle, 15163
swell, 15470
sheepshead, 15027
shiner,
coastal, 14453
common, 15523, 15597
emerald, 14805, 15171
golden, 14442, 14748, 15087, 15511, 15553
red, 14580, 15072, 15397
Red River, 15397
silverside,
Atlantic, 15459
Mississippi, 14438
skilletfish, 14890
smelt, 15347
American, 15018
rainbow, 14730, 15171, 15311, 15555
sole, 15009, 15124
butter, 15467
Dover, 14942
English, 14494, 14815, 15376
flathead, 14494
lined, 14268
petrale, 14815
rock, 15376
splake, 14415, 15018, 15076
Specific, cont.
spot, 14255, 15323, 15380, 15404
squawfish, northern, 15551
sterlet, 14792, 14923
stickleback,
brook, 15371
ninespine, 14915, 15189
threespine, 14236, 14472
studfish, northern, 15197
sturgeon, 14529, 14914, 15227
beluga, 14872, 14923
green, 14939, 15357
lake, 15332, 15345
Russian, 14923
spiny, 14389, 14872
stellate, 14392, 14923, 15125
white, 14939, 14941
sucker, 14868, 15379
longnose, 14759, 15016
Sonora, 15310
white, 14336, 14503, 14626, 14640, 14759, 14963, 15171, 15191, 15434, 15615
sunfish, 14557, 14673, 15068
green, 14439, 14769, 15103, 15176, 15237
green X bass, largemouth, 15052
longear, 14802, 15200
redbreast, 14345, 15399, 15524
redear, 14343, 14439, 14457, 14886
redear X bluegill, 15054
redear X sunfish, green, 15099
surfperch, silver, 14816
tautog, 15040
tench, 14889
Tilapia, 14320, 14616, 15006, 15531 15608
aurea, 14320, 14328, 14333, 15019
mossambica, 14504
vulcani, 14320
zillii, 14328
topminnow, blackstripe, 15417
Trachurus mediterraneus, 14274
trout, 14341, 14480, 14624, 14657, 14694, 14715, 14966, 15016, 15039, 15119, 15163, 15240, 15275, 15283, 15289, 15325, 15348, 15350, 15351, 15352, 15355
brook, 14246, 14288, 14306, 14352, 14415, 14498, 14506, 14565, 14566, 14693, 14788, 14803, 14810, 14908, 14996, 15018, 15029, 15076, 15098, 15111, 15145, 15174, 15220, 15312, 15321, 15395, 15421, 15465, 15481, 15542, 15565, 15572, 15582, 15583, 15612, 15616
brown, 14352, 14566, 14642, 14881, 14897, 14901, 14903, 14904, 14912, 15018, 15043, 15094, 15098, 15128, 15190, 15203, 15242, 15308, 15321,

Specific, cont.
trout, cont.
brown, cont., 15337, 15339 15342, 15382, 15384, 15390, 15421, 15582
cutthroat, 14447, 14496, 14729, 15145, 15179, 15259
lake, 14415, 15018, 15132, 15256, 15311, 15328, 15330, 15332, 15334, 15335, 15344, 15345, 15347, 15615
rainbow, 14239, 14240, 14267, 14275, 14295, 14316, 14352, 14435, 14443, 14458, 14466, 14467, 14488, 14489, 14490, 14495, 14559, 14567, 14609, 14625, 14631, 14635, 14666, 14695, 14703, 14722, 14726, 14728, 14735, 14758, 14765, 14768, 14771, 14777, 14778, 14779, 14819, 14820, 14836, 14838, 14840, 14842, 14844, 14845, 14847, 14853, 14854, 14857, 14872, 14881, 14882, 14889, 14897, 14958, 14971, 14973, 14978, 15018, 15048, 15049, 15055, 15056, 15058, 15060, 15070, 15071, 15073, 15076, 15098, 15100, 15114, 15117, 15118, 15120, 15142, 15152, 15187, 15190, 15211, 15246, 15247, 15248, 15249, 15296, 15306, 15319, 15336, 15342, 15379, 15400, 15424, 15449, 15465, 15475, 15543, 15560, 15582, 15583, 15587, 15606, 15622
Specific, cont.
sea, 14872, 15476
Sevan, 15221
steelhead, 14408, 14458, 14572, 14727, 14979, 15038, 15050, 15051, 15069, 15080, 15199, 15214, 15463
tuna, 14645, 14654, 15278, 15361
bluefin, 14233, 14243
skipjack, 14233, 14269, 15422, 15447
yellowfin, 14632, 15416, 15452
walleye, 14238, 14291, 14500, 14700, 14713, 14730, 15016, 15018, 15096, 15212, 15311, 15345, 15429, 15440, 15621
warmouth, 14437, 14886
whitefish, 14458, 15966, 15156, 15190, 15275, 15334, 15336, 15338, 15347, 15405
humpback, 15328
lake, 15016, 15018, 15330, 15332, 15344, 15345, 15577
round, 14885, 15218
yakataisaki, 14836
yellowtail, 15445
zebrafish, 14639, 15109
zope, 14866

Stocking,
bass, largemouth, evaluation of 3 strains stocked in Alabama ponds, 15503
chub, Mojave, an endangered species, 14418
density, channel catfish in tanks, re growth and food conversion, 14363
effects on,
fishery resources of Lake Erie, 15345
salmonid community of Lakes, 15332, 15333, 15334, 15335, 15336, 15337, 15338, 15342, 15343, 15344, 15347, 15352
fishes and invertebrates in 1967, USSR, 14394
herbivorous fishes,
in cooling reservoirs in USSR, 14741
used for amelioration in Europe, 15017
in SCOL lakes, Canada, review of management approach, 15324
perch, white, in Nebraska, 14454
phytophagous fishes in USSR, results, 14417
results, bass-bluegill-redear sunfish in ponds less than 0.25 acre, 14343
Salmo trutta lacustris in dam reservoir at Przeczyce, Poland, 15386
salmon,
Atlantic, rehabilitation in East River, Nova Scotia, 15601
kokanee, in Lake Huron, 14975
salmonids, into barren lakes, effects, 15325
Saskatchewan waters, 1900-1969, history and results of fish introductions, 15018

Stocking, cont.
splake, planted in Ontario lakes, 15076
trout,
brook, planted in Ontario lakes, 15076
brown, contribution to self-sustaining fishery, Sydenham River, Canada, 15384
rainbow, planted in Ontario lakes, 15076

Survival,
acclimation, heterogeneous, of fish to temperature, 15395
acid stress in fish, histochemical and cytophotometric assay of, 14908
activity response of brook trout to chlorine, 14996
alewife dieoffs, reasons for occurrence, 14248
anchovy and sardine larvae in laboratory, effect of food level on, 15318
bass,
largemouth,
re insecticide residues from 2 Mississippi oxbow lakes, 14330
tagged-, in Merle Collins Reservoir, 15464
striped,
developing eggs and fry, effects of temperature changes on, 14329
eggs and larvae, effects of temperature, salinity and D.O. on, 14420
fry stocked in earthen ponds, re their age, source and water hardness, 15522
oxygen requirements re salinity and handling, 14970
biological magnification of PCB from water by invertebrates, 15129
bluegill,
confirmation of autopsy technique for fish mortality from zinc, 14462
time until death under thermal and zinc stress, 14276
vertebral damage from exposure to acute doses of pesticides, 15184
bullhead, exposure time required against antimycin and rotenone for death, 15079
carp, exposure time required against antimycin and rotenone for death, 15079
catfish, channel,
effects of salinity on, 14334
juvenile, rate of acclimation to high temperatures, 14446
communities, aquatic, response to spills of hazardous materials, 15451
croaker, in brackish water ponds, 14325
cyprinid marked with fluorescent pigments, 14724
early-, of ninespine stickleback, 15189
effect of salinity stress on eggs and larvae of Salton Sea fishes, 14814
effects of,
dart tags on yellow perch, 15194
Floy anchor tag on brook trout, 15220
hydrogen sulfide on fish eggs and fry, 15314
malathion on pond fishes and invertebrates, 15610
phenylmercuric acetate on hatching frequency of zebrafish eggs, 15109
phosphorous halides on fish ontogeny, 15125
washing enzymes on fishes and other water organisms, 14954
zectran on trout and benthos in Bear Valley Creek, Idaho, 15186
eggs,
fish, infestation with Leucothrix mucor, 14793
of autumn-spawning rainbow trout in artificial incubation, 15247
rainbow trout-, significance of carotenoids and vitamin A in early embryogenesis, 15114
escapement and productivity of Nushagak sockeye run, 1908-66, 14404
fish,
and their food, chronic effects of urea-derivative herbicides, 14932
death during transportation, bacteriological study concerning, 14835
influence of water temperature on, 14540
life, normal-, minimum dissolved oxygen required for, 14838
re low pH and high content of Fe compounds, 14587
semi-migratory-, of Don River, influencing factors, 14911
tolerance to dissolved nitrogen, 14253

Survival, cont.
fishes in alkaline eutrophic waters of Nebraska, 14769
fishkill, thermal-pollution-, 14283
forensic ichthyological examination, principles for, 15609
herbivorous fishes,
rearing experience in Czechoslovakia, 14736
stocked in cooling reservoirs, USSR, 14741
herring, Pacific, effect of intertidal exposure on egg survival and development, 15614
ichthyotoxicology, role of pathological anatomy in, 14431
juvenile fish in Kremenchug Res., USSR, re "blooming" of water, 14526
larvae of blenny, goby, skilletfish, oxygen requirements of, 14890
mortality,
curves of bluegills under temperature and zinc stress, 15578
natural- and fishing-, estimation from tag recaptures, 15594
of,
fingerling chinook salmon re egg size, 15088
striped bass due to Goezia sp., in Fla., 15516
mosquitofish, rotenone tolerance in, 15127
omul, Baikal, eggs, in Kichera River re flow, 14870
perch, white, in Delaware River near artificial island, 14544
percid hybrids, intergroup-, 14482
poisoning, sublethal-, rotatory-flow technique for detection in fish, 14860
pupfish, desert, 14433
re subcutaneous hemorrhage in captive sablefish, 15433
resistance,
insecticide-, possible mechanism in mosquitofish, 14533
of dominant and submissive bluegills to lethal zinc concentration, effect of shelters on, 15544
responses of brown bullhead to MS-222, 14708
rotenone tolerances of some freshwater fishes of Natal, 14364
salinity tolerance of catfish hybrids, 14445
salmon,
chinook,
effects of passage thru a pump, 14367
fall-, from Columbia River hatchery, ocean mortality, maturation and yield, 14228
pink, to adulthood, evaluation by revised method, 15618
sockeye, response of young to prolonged starvation, 14761
salmonids,
collection at turbine intake of dam, 15199
juvenile, thermal tolerance re N supersaturation, 14408
sensitivity of,
certain hydrobionts to radioactive strontium, 15130
white amur to fish toxicants, 14707
shiner, golden, high lethal temperatures of, 14748
size-selective predation among juvenile salmonids in British Columbia inlet, 14600
smelt, re threat of thermal pollution of Columbia River, 14591
snails, correlation of structure vs. activity of freshwater pollutants, 14905
splake, planted in Ontario lakes, 15076
spot, juvenile, critical thermal maximum, 14255
sucker, white,
exposure time required against antimycin and rotenone for death, 15079
lethal pH for, 15191
threatened freshwater fishes of the U. S., 15172
tolerance of,
bluegill and rainbow trout to road salt, 14722
juvenile sockeye and zooplankton to squoxin, 15551
young striped bass to 9 pond-culture chemicals, 14669

Survival, cont.
toxic effect of,
cadmium on mummichog re different environmental parameters, 15168
phenasal and devermine antihelminthics on fish, 14400
toxicity,
acute,
and breakdown studies of methoxychlor, 15181
and chronic, of cadmium to fathead minnow, 15611
of,
α-TNT to bluegills, 15460
copper-, nickel-, and zinc ions to some Hudson River fishes, 14581
organochlorine insecticides to surfperches, 14945
polyoxyethylene esters and ethers to salmon and Gammarus, 15297
spent sulphite liquor to Atlantic salmon, 15625
yellow phosphorus to cod and salmon smolts, 15539
fish-, of pesticides with high content of 4,6-dinitro-O-cresol, 14281
of,
aluminum hydroxide complexes to rainbow trout, re pH, 14443
cadmium to mummichog and other organisms, 14492
chloramine to fathead minnow, 14972
chlorinated municipal waste to trout and minnow, 15606
chlorine residuals to freshwater fish, 14875
chlorine to brown trout, 14642
crude oils and dispersants to shrimp, 15534
2,4-D to fish, 14692
dursban to fish and aquatic invertebrates in ponds, 15575
mercury to phytoplankton, 15138
nifurpirinol to salmonids, 15301
oil-spill removers, 15569
organometallic compounds for hydrobionts re chemical composition, 15143
picloram to fish, 14692
some chlorine-containing herbicides for fish, 14401
zinc to bluegill, effects of pH, solubility and temperature, 14906
toxicological,
assays with fish, 14592
effects of herbicides and weed control on fish et al, 14583
trout,
brook,
planted in Ontario lakes, 15076
young-, temperature re growth and survival, 15612
in Finnish lakes treated with rotenone, 14897
in Sagehen Creek, Calif., effects of floods on, 15583
rainbow,
DDT intoxication as affected by dieldrin, 15400
2 domestic strains stocked in Calif. lake, 14819
exposed to X-rays as eyed embryo, 14295
fry, effect of starvation and rate of artificial feeding during winter, 15249
hatchery-, re stamina tunnel ratings, 15424
infected with Sanguinicola davisi, 14435
planted in Ontario lakes, 15076
tuna, yellowfin, mortality estimates in E. Pacific via tagging, 14632
vulnerability of fin-clipped bluegill to predation by bass in tanks, 15599
young fish in discharge canal of nuclear plant, 14245

Vegetation,
alga, effect of pesticides on growth and ^{14}C assimilation of, 15299
algae growth as cause of tag loss from juvenile chinook, Ore., 14242
algicides, evaluation of, 14623
changes re water level stabilization in Lake Okeechobee, Fla., 14661
Cladophera glomerata, development of growth curve re temperature and photoperiod, 15285

Vegetation, cont.
control with anhydrous ammonia in fisheries management, 14347
ecological significance to northern pike spawning, 15604
herbicides, clearance and registration for aquatic use, 14225
herbivorous fish, used for amelioration in Europe, 15017
hydrophytic changes re lake fluctuation, measured by point transects, 15526
macrophytes,
distribution, production and role in S. Michigan marl lake, 14464
factors of photosynthesis and organic-matter excretion in hard-water lakes, 14548
phytophagous fishes, results of acclimatization in USSR, 14417
sargassum complex, fishes associated with, 15366
uptake and effects of dichlobenil in a small pond, 14578
water hyacinth, nutritional value in channel catfish feeds, 14806
weed control and herbicides, toxicological effects on fish and other organisms, 14583
weeds, aquatic-,
control with white amur, 15065
controlled by grass carp in India, 14745

Virology,
channel catfish virus,
a new herpesvirus of ictalurids, 14862
disease, histopathologic changes in, 15077
research at Auburn University, Alabama, 14797
tissue distribution of, 14812
IHN,
pathogenesis of, 15207
virus survey for, in Washington salmon, 15556
IPN,
pathogenicity of isolants from rainbow trout in Japan, 14845
virus,
effect of actinomycin D on multiplication of, 14615
epidemiological model for passive transfer by homeotherms, 15389
first isolation from epizootics in Japan, 14843
frequencies of isolation from brook trout, 14246
isolated from white suckers, 14963
isolation from asymptomatic carrier fish, 15175
of salmonids in Ontario, 14506
lymphocystis, new records in 4 eastern Pacific fishes, 14767
monolayer tissue culture, prepared from carp gonads, 15403
viral-host interactions in RTG-2 cell line, effect of zinc on, 14376
virus-caused epizootic of rainbow trout in Minnesota, 14735
viruses,
electro-osmosis - a new technique for concentrating from water, 15381
(OSV, SRCV and IHN), antigenic relationships by cross neutralization, 14541
salmonid-, virucidal activity of 2 iodophors against, 15034

The following publications were screened for Volume 17. Abstracts not covered by this list are of irregularly published papers, are contributions of cooperating abstracters, or are of separates from publications not regularly received by the Main Library or Pell Library of the University of Rhode Island.

Acta Hydrobiologica, Zaklad Biologii Wod, Polska Akademia Nauk, Krakow, Poland
Acta Zoologica, Svenska Bokförlaget, Fack, 10420, Stockholm 8, Sweden
American Midland Naturalist, University of Notre Dame, Notre Dame, Indiana
American Naturalist, The, The University of Chicago Press, Chicago, Illinois
American Scientist, Society of the Sigma Xi, 33 Witherspoon St., Princeton, N. J.
American Zoologist, American Soc. of Zoologists, 104 Liberty St., Utica, N. Y.
Animal Behaviour, Animal Behaviour Soc., Bailliere, Tindall and Cassell, London, England
Annales D'Hydrobiologie, Institut National de la Recherche Agronomique, 149, rue de Grenelle, Paris - 7e, France
Annales Zoologici Fennici, Societas Biologica Fennica Vanamo, Helsinki, Finland
Antonie Van Leeuwenhoek, Netherlands Soc. for Microbiology, Swets & Zeitlinger, Keizersgracht 471, Amsterdam, The Netherlands
Applied Microbiology, American Soc. for Microbiology, 4715 Cordell Ave., Bethesda, Maryland
Archiv für Fischereiwissenschaft, Westliche Berliner Verlagsgesellschaft, Heenemann KG, Berlin - Wilmersdorf, Germany
Archiv für Hydrobiologie, E. Schweizerbartsche Verlagsbuchhandlung (Nägele u. Obermiller) Johannsstrasse 3A, 7000 Stuttgart 1, West Germany
Archiv für Mikrobiologie, Springer - Verlag New York, Inc., 175 5th Ave., N. Y.
Archiv für Protistenkunde, VEB Gustav Fischer Verlag, Jena, East Germany
Arkiv för Zoologi, Almquist & Wiksell, Stockholm, Sweden
Australian Journal of Marine and Freshwater Research, Commonwealth Scientific & Industrial Research Organization, 314 Albert S., East Melbourne C2, Australia
Bamidgeh, Dept. of Fisheries, Fish Breeders Assoc., Nir-David, N. N., Israel
Behaviour, E. J. Brill, Publishers, Leiden, Holland
Biochemical Journal, The, Cambridge Univ. Press, 200 Euston Rd., London N.W. 1, England
Biological Bulletin, The, The Marine Biological Laboratory, Woods Hole, Mass.
Biological Conservation, Elsevier Publishing Co., Barking, Essex, England
Biological Reviews, Cambridge Univ. Press, 200 Euston Road, London, N.W. 1, England
Bioscience, American Inst. of Biological Sciences, 3900 Wisconsin Ave., N. W., Washington, D. C.
Bulletin, Fisheries Research Board of Canada, 116 Lisgar St., Ottawa 4, Ontario, Canada
Bulletin, Inter-American Tropical Tuna Commission, La Jolla, California
Bulletin, International North Pacific Fisheries Commission, Vancouver, British Columbia, Canada
Bulletin of Environmental Contamination and Toxicology, Springer Verlag, New York, Inc., 175 Fifth Ave., New York, N. Y.
Bulletin of Marine Science, Univ. of Miami Press, Coral Gables, Florida
Bulletin of the American Museum of Natural History, New York, N. Y.
Bulletin of the Faculty of Fisheries, Hokkaido Univ., Hakodate, Japan
Bulletin of the Faculty of Fisheries, Nagasaki Univ., Nagasaki, Japan
Bulletin of the Hokkaido Regional Fisheries Research Laboratory, Yoichi, Hokkaido, Japan
Bulletin of the Japan Sea Regional Fisheries Research Laboratory, Nigata, Japan
Bulletin of the Japanese Soc. of Scientific Fisheries, Tokyo, Japan
Bulletin of the Sekai Regional Fisheries Laboratory, Nagasaki, Japan
Bulletin of the Tokai Regional Fisheries Research Laboratory, Tokyo, Japan
Bulletin of Tohoku Regional Fisheries Research Laboratory, Shiogama, Miyagi Pref., Japan
California Fish and Game, The Resources Agency of Calif., 987 Jedsmith Drive, Sacramento, California

Canadian Field Naturalist, The, Ottawa Field-Naturalists Club, Ottawa, Ontario, Canada
Canadian Journal of Microbiology, The National Research Council of Canada, Ottawa 7, Canada
Canadian Journal of Zoology, Natural Resources Council, Ottawa 7, Ontario, Canada
Chemico-Biological Interactions, Elsevier Publishing Co., Amsterdam, Netherlands
Chesapeake Science, Natural Resources Inst. of the Univ. of Maryland, Chesapeake Biological Laboratory, Solomons, Maryland
Commercial Fisheries Abstracts, NOAA, NMFS, Scientific Publications Staff, Bldg. 67, Naval Support Activity, Seattle, Washington
Comparative Biochemistry and Physiology, Pergamon Press, Headington Hill Hall, Oxford OX 3, OBW, England
Contributions in Marine Science, The Univ. of Texas Marine Science Institute, Port Aransas, Texas
Copeia, American Soc. of Ichthyologists and Herpetologists, Div. of Reptiles and Amphibians, U. S. National Museum, Washington, D. C.
Crustaceana, E. J. Brill, Leiden, The Netherlands
Die Naturwissenschaften, Organ der Max-Planck-Gesellschaft zur Forderung der Wissenschaften, Organ der Gesellschaft Deutscher Naturforscher und Arzte, Springer-Verlag, Berlin, Germany
Ecological Monographs, Duke Univ. Press, Durham, North Carolina
Ecology, The Ecological Soc. of America and the Duke Univ. Press, Durham, N. C.
Endeavor, Imperial Chemical Indistries, Ltd., North Block, Thames House, Millbank, London S. W. 1, England
Environmental Pollution, Elsevier Publishing Co., Ltd., Ripple Road, Barking, Essex, England
Environmental Research, Academic Press, Inc., 111 Fifth Ave., New York, N. Y.
Environmental Science and Technology, American Chemical Soc., 1155 16th St. N. W., Washington, D. C.
Eutrophication Abstracts, The Univ. of Wis. Water Resources Center Eutrophication Program, 1324 W. Dayton St., Madison, Wisconsin
Evolution, The Soc. for the Study of Evolution, 1041 New Hampshire St., Lawrence, Kansas
Experientia, Birkhauser Verlag, Basel, Switzerland
F. A. O. Aquaculture Bulletin, Food and Agriculture Organization of the United Nations, Rome, Italy
F. A. O. Circulars, FAO of the United Nations, Rome, Italy
F. A. O. Fisheries Reports, FAO of the United Nations, Rome, Italy
F. A. O. Fisheries Synopsis, FAO of the United Nations, Rome, Italy
F. A. O. Fisheries Technical Papers, FAO of the United Nations, Rome, Italy
Fishery Bulletin, Calif. Fish and Game Commission, Sacramento, California
Fishery Bulletin, U. S. Dept. of Commerce, NOAA, NMFS, Seattle, Washington
Fishery Disease Leaflet, Bur. Sport Fisheries & Wildlife, Fish & Wildlife Service, U. S. Dept. of the Interior, Washington, D. C.
Fishery Leaflet of the Dept. of Commerce, NOAA, NMFS, Publications Bldg. 67, Naval Support Activity, Seattle, Washington
Fiskeridirektoratets Skrifter, Serie Havundersøkelser, Directorate of Fisheries, Bergen, Norway
General and Comparative Endocrinology, Academic Press, New York, N. Y.
Gulf Research Reports, Gulf Coast Research Lab., Ocean Springs, Mississippi
Heredity, Oliver and Boyd, Ltd., Tweeddale Court, Edinburgh, Scotland
Hydrobiologia, Acta Hydrobiologica Hydrographica et Protistologica, The Hague, Holland
Hydrobiological Journal, Scripta Technica, Inc., 1511 K St. N. W., Wash., D. C.
Institute of Freshwater Research, Fishery Bd. of Sweden, Drottningholm, Sweden
Internationale Revue der Gesamten Hydrobiologie, Akademie-Verlag GmbH, 108 Berlin, Leipziger St. 3-4, West Germany
Investigations in Fish Control, Fish & Wildlife Service, Dept. of Interior, Washington, D. C.
Iowa State Journal of Science, Iowa State Univ. Press, Inc., Ames, Iowa

Japanese Journal of Ecology, Sendai, Japan
Japanese Journal of Ichthyology, Tokyo, Japan
Journal Du Conseil, Le Bureau du Conseil, Copenhagen, Denmark
Journal of Animal Ecology, The, British Ecological Soc., 5 Alfred St., Oxford, Eng.
Journal of Applied Ecology, The, British Ecological Soc., 5 Alfred St., Oxford, Eng.
Journal of Biological Chemistry, The, The American Soc. of Biological Chemists, Inc., 9650 Rockville Pike, Bethesda, Maryland
Journal of Ecology, The, British Ecological Soc., 5 Alfred St., Oxford, England
Journal of Experimental Biology, The, The Company of Biologists, Ltd., Cambridge Univ. Press, 200 Euston Rd., London N.W. 1, England
Journal of Experimental Marine Biology and Ecology, North Holland Publishing Co., P. O. Box 3489, Amsterdam, The Netherlands
Journal of Experimental Zoology, The, The Wistar Inst. of Anatomy and Biology, Wistar Inst. Press, 36th Street at Spruce, Philadelphia, Pa.
Journal of Faculty of Fisheries, Prefectural Univ. of Mie, Tsu, Japan
Journal of Fish Biology, Fisheries Soc. of the British Isles, Academic Press, Ltd., Berkeley Square, London, England
Journal of General Microbiology, The, The Society for General Microbiology, Cambridge Univ. Press, Bentley House, 200 Euston Rd., London N.W. 1, England
Journal of Ichthyology (Voprosy Ikhtiologii), The American Fisheries Society, Scripta Technica, Inc., 1000 Vermont Ave. N. W., Washington, D. C.
Journal of Immunology, American Assoc. of Immunologists, Williams & Wilkins Co., Baltimore, Maryland
Journal of Marine Research, Bingham Oceanographic Lab., Yale Univ., New Haven, Connecticut
Journal of Natural History, Cannon House, Macklin St., London, England
Journal of Parasitology, American Soc. of Parasitologists, Rm. 1711, 333 North Michigan Ave., Chicago, Illinois
Journal of Protozoology, The, Soc. of Protozoologists, 1041 New Hampshire St., Lawrence, Kansas
Journal of Soil & Water Conservation, Soil Conservation Soc. of America, 7515 N. E. Ankeny Road, Ankeny, Iowa
Journal of the Elisha Mitchell Scientific Society, N. C. Academy of Science, Chapel Hill, North Carolina
Journal of the Faculty of Fisheries and Animal Husbandry, Hiroshima Univ., Fukuyama, Japan
Journal of the Fisheries Research Board of Canada, Ottawa, Ontario, Canada
Journal of the Marine Biological Assoc. of the United Kingdom, Cambridge Univ. Press, London, England
Journal of the Tokyo University of Fisheries, Tokyo, Japan
Journal of Virology, American Soc. for Microbiology, 4715 Cordell Ave., Bethesda, Maryland
Journal of Wildlife Management, Wildlife Soc., 3900 Wisconsin Ave. N.W., Suite S-176, Washington, D. C.
Journal of Zoology, The Zoological Soc. of London, Academic Press, Ltd., Berkeley Square, London, England
Journal Water Pollution Control Federation, 3900 Wisconsin Ave., Washington, D.C.
Limnologica, Deutsche Akademie der Wissenschaften zu Berlin Forschungsstelle für Limnologie, Akademie-Verlag, Berlin, Germany
Limnology and Oceanography, The American Soc. of Limnology and Oceanography, Inc., Lawrence, Kansas
Marine Biology, Springer-Verlag New York, Inc., 175 Fifth Ave., New York, N.Y.
Marine Technology Society Journal, Marine Technology Soc., 1730 M St., N.W., Washington, D. C.
Memoirs of the Faculty of Fisheries, Kagoshima Univ., Kagoshima, Japan
Nature, MacMillan, Ltd., 711 National Press Bldg., Washington, D. C.
Nature New Biology, MacMillan, Ltd., 711 National Press Bldg., Washington, D.C.
Netherlands Journal of Sea Research, 1 Horntje, P. O. Box 59, Texel, Netherlands
New York Fish and Game Journal, N. Y. Conservation Dept., Albany, New York
New Zealand Journal of Marine and Freshwater Research, Dept. of Science & Industrial Research, Box 8018, Wellington, New Zealand

NOAA Technical Report, Special Scientific Reports - Fisheries, U. S. Dept. of Commerce, National Marine Fisheries Service, Washington, D. C.
NOAA Technical Report (NMFS Circular), U. S. Dept. of Commerce, NOAA, NMFS, Scientific Publication Staff Bldg. 67, Seattle, Washington
Nytt Magasin for Zoologi, Universitetsforlaget, Postboks 307, Blindern, Oslo 3, Norway
Oceanology (Okeanologiya), American Geophysical Union, Suite 435, 2100 Pennsylvania Ave. N. W., Washington, D. C.
Oikos, Acta Oecologica Scandinavica, Munksgaard International Booksellers and Publishers, Copenhagen, Denmark
Pacific Science, Univ. of Hawaii, Honolulu, Hawaii
Parasitology, Cambridge Univ. Press, Bentley House, 200 Euston Rd., London N. W. 1, England
Philosophical Transactions of the Royal Society of London, Royal Society, 6 Carlton House Terrace, London S.W. 1, England
Physiological Zoology, Univ. of Chicago Press, Chicago, Illinois
Proceedings of the National Academy of Sciences, 2101 Constitution Ave., Washington, D. C.
Proceedings of the Royal Society of Edinburgh B, The Royal Society of Edinburgh, 22 George St., Edinburgh 2, Scotland
Proceedings of the Royal Society of London B, Royal Society, 6 Carlton House Terrace, London S.W. 1, England
Proceedings of the Southeastern Assoc. of Game and Fish Commissioners (Annual conference), P. O. Box 167, Columbia, South Carolina
Progressive Fish Culturist, The, Bureau of Sport Fish. & Wildl., U. S. Dept. of the Interior, Washington, D. C.
Publicazioni Della Stazione Zoologica di Napoli, Stazione Zoologica di Napoli, Naples, Italy
Quarterly Review of Biology, The, Stony Brook Foundation, Inc., 1323 Greenwood Road, Baltimore, Maryland
Research Reports, U. S. Fish & Wildlife Service, Department of the Interior, Washington, D. C.
Research Reports of the Fish Commission of Oregon, 307 State Office Bldg., Portland, Oregon
Resource Publications, Bureau of Sport Fish. & Wildl., Department of the Interior, Washington, D. C.
Revue Canadienne de Biologie, Les Presses de l'Universite de Montreal, Montreal, Canada
Rivista Italiana di Piscicultura e Ittiopatologia, Via Independenza, 31100 Treviso, Italy
Rybnoe Khozyaistvo, Fishery Ministry, V. Krasnosel'skaya 17, Moscow, B-140, USSR
Science, American Assoc. for the Advancement of Science, 1515 Massachusetts Ave., N.W., Washington, D. C.
Scientific American, Scientific American, Inc., 415 Madison Avenue, New York, New York
Selected Water Resources Abstracts, U. S. Dept. of Commerce, National Technical Information Service, Springfield, Virginia
Southwestern Naturalist, The, The Southwestern Association of Naturalists, Austin, Texas
State of Florida Board of Conservation Technical Series, Florida State Board of Conservation, P.O. Drawer F, St. Petersburg, Florida
Systematic Zoology, Soc. of Systematic Zoology, Allen Press, Inc., 1041 New Hampshire St., Lawrence, Kansas
Technical Papers, Bureau of Sport Fish. & Wildl., U. S. Dept. of the Interior, Washington, D. C.
Toxicology and Applied Pharmacology, Academic Press, Inc., 111 Fifth Ave., New York, N. Y.
Transactions of the American Fisheries Society, Allen Press, Inc., Lawrence, Kansas

Transactions of the American Microscopical Society, Allen Press, Inc., 1041 New Hampshire St., Lawrence, Kansas
Tuatara, Biological Society, Victoria University of Wellington, Wellington, New Zealand
Tulane Studies in Zoology and Botany, New Orleans, Louisiana
Veroffentlichungen des Instituts für Meeresforschung in Bremerhaven, Kommissionsverlag Franz Leuwer, Bremen, West Germany
Water Research, Pergamon Press, Ltd., Maxwell House, Fairview Park, Elmsford, New York
Water Resources Bulletin, American Water Resources Assoc., 103 North Race St., Urbana, Illinois
Water Resources Research, American Geophysical Union, Publisher: 2901 Byrdhill Road, Richmond, Virginia
Weed Science, Weed Science Society of America, Ohio State Univ., 1827 Neil Ave., Columbus, Ohio
Zeitschrift für Morphologie der Tiere, Springer-Verlag New York, Inc., 175 Fifth Ave., New York, N. Y.
Zoologica, New York Zoological Society, New York, N. Y.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1973 O - 493-184

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of this department of natural resources.

The Department works to assure the wisest choice in managing all our resources so that each shall make its full contribution to a better United States now and in the future.